CPU ROADMAP: WHAT'S NEW & COMING SOON

#546
JUNE 2025

apc

YOUR EXPERT GUIDE
TO TODAY'S TECH

SINCE 1980

BUILD YOUR OWN NETFLIX!

10 BRILLIANT NAS DRIVES TESTED

- TAKE CONTROL OF YOUR FILES
- RUN A PRIVATE CLOUD

EASY LINUX INSTALL GUIDE!
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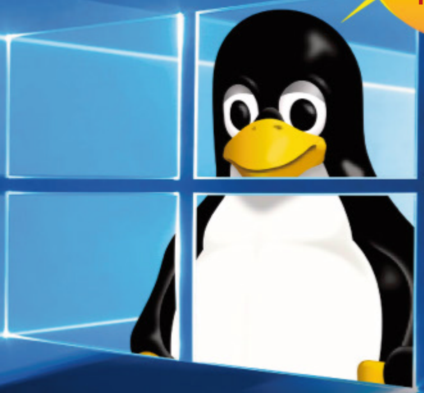

RATED

Google Pixel 9a

IS THIS THE BEST ALL-ROUND PHONE OF 2025?

8 BEST LINUX DISTROS REVIEWED

HOW TO BEAT THE END OF WINDOWS 10

SWITCHING TO LINUX MADE EASY

✻ Moving from Windows ✻ Run your OS from a USB drive ✻ Put your old PC to good use

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GAME TESTED

Nvidia RTX 5060Ti

GAMING'S NEXT-GEN BUDGET BLASTER

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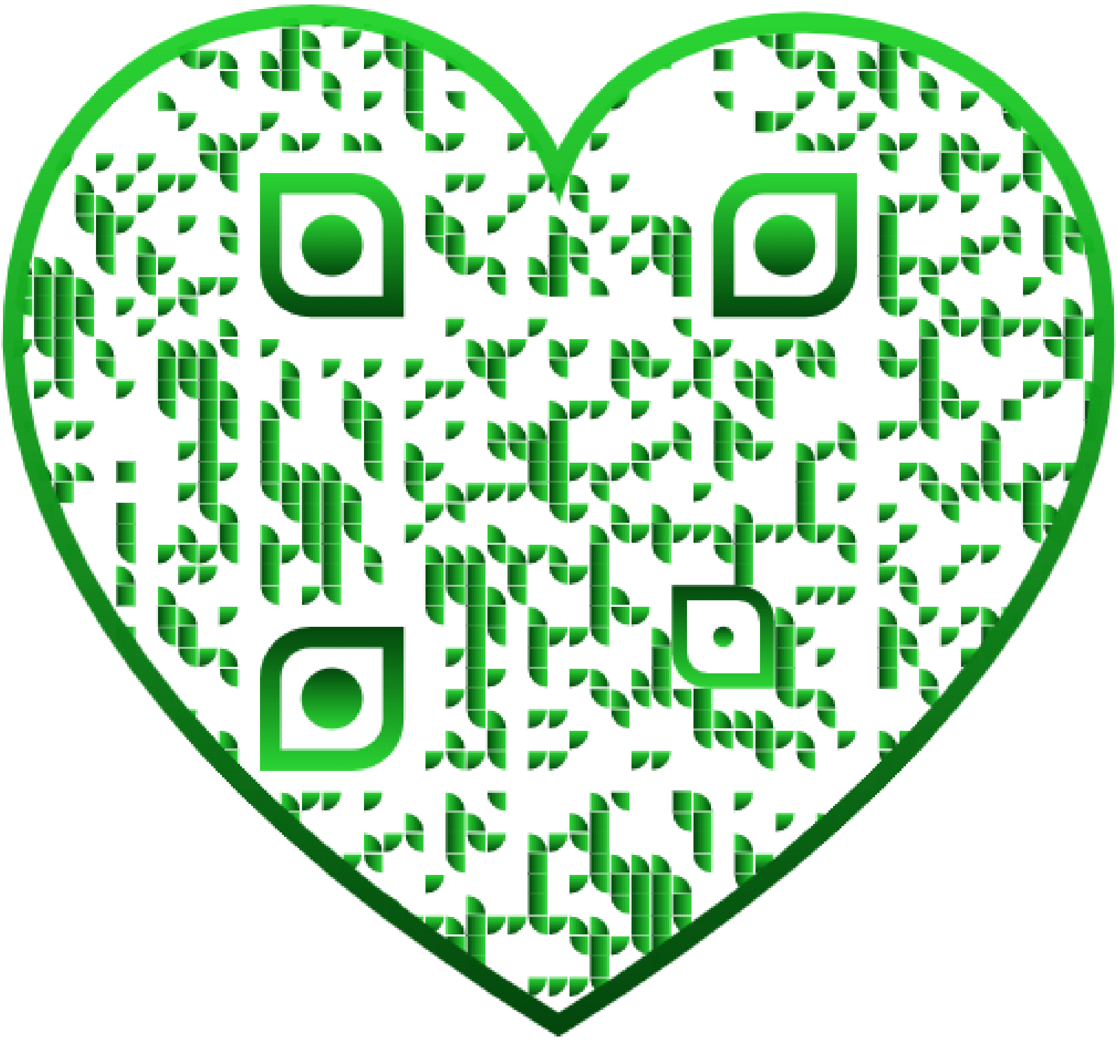

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Windows forever?

Linux has never looked better

Hi everyone, and welcome to another most excellent issue of *APC*. This month we're feeling the tides of change and have produced a properly big article about Linux as a viable alternative to Windows. As you probably know, Windows 10 goes end of life this year, and while Windows 11 may beckon for many, Linux makes for a fascinating choice.

It isn't what it used to be. You may have dabbled, or considered making the switch in the past, and perhaps been put off by the intimidating landscape of choice plus the seemingly hardcore technical aspects. Things are as simple as can be now. In this issue we've got a step-by-step setup guide that shows it's as easy – if not easier – than Windows to get up and running. And don't be put off by our advanced Linux tutorials in previous issues of the magazine – if all you want is a friendly to use and reliable desktop which can do all the same tasks as Windows, Linux is a gift. We've compared the top distros, too, so picking which flavour of Linux is painless, and a bit of fun, too.

You can even load Linux up on an old, spare PC you might have and have a bit of a tinker. It's very appealing as a new project and doesn't need to cost a single cent.

Meanwhile in the Labs, the team has put together a massive guide to the state of play with NAS devices, loading up with good info to help you get more from your own personal cloud, along with reviews of some of the best NAS devices on the market.

Elsewhere in *APC*, you might notice a few changes here and there. We've refreshed some sections like Blueprints, and added more content of the sort we hope you like. We'll be doing more How To guides now, too. We also say goodbye to a couple of sections, with the Q&A 'Problem Solvers' pages being retired, as well as the opinion pages Tech Talk and Trade Chat.

For Blueprints, we've expanded the number of components and peripherals we cover and give space to explain why we recommend each item, instead of going on about the woes and misery of the market itself. All small changes, but just a little mid-year evolution for *APC* that we hope you like.

Until next month! ■

MEET THE TEAM Along with Australia's best tech journos, our core crew work hard to make *APC* a great read every month.

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Lindsay has been writing for *APC* for over a decade and loves nothing more than spending all day every day benchmarking the latest hardware.

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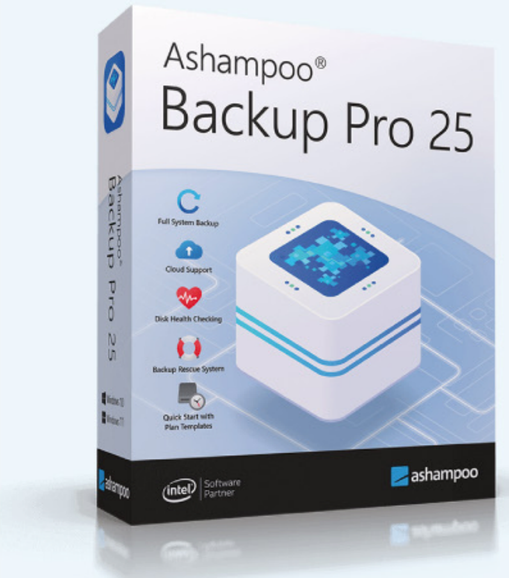

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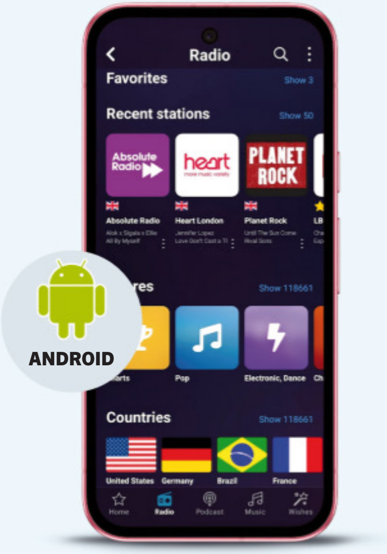

ASHAMPOO BACKUP 2025

BACK UP AND RESTORE FILES WITH EASE.

Ashampoo Backup Pro 25 is Windows-based a comprehensive backup solution to back up or restore any file, partition or bootable operating system. Real-time file monitoring updates backups fully automatically on file modifications. Archives can easily be restored in the event of hardware issues or system malware infections. Backups can be created fully automatically thanks to smart background technology that does not interfere with normal PC operation. For that, Ashampoo Backup Pro 25 monitors the system load and only becomes active when enough resources are available. Four different compression methods and strong encryption ensure space-efficient and secure backup.

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SIMPLE MUSIC RECORDING.

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Gaming Monitor in Australia*

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Samsung OLED Safeguard+

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Blazing speed and near instantaneous reactions

Gaming Hub

Quick access to your favourite games in one place

*Source : IDC Worldwide Quarterly Gaming Tracker. Based on value (amount) from 2023-2024.Q3, gaming segment 144Hz and above.

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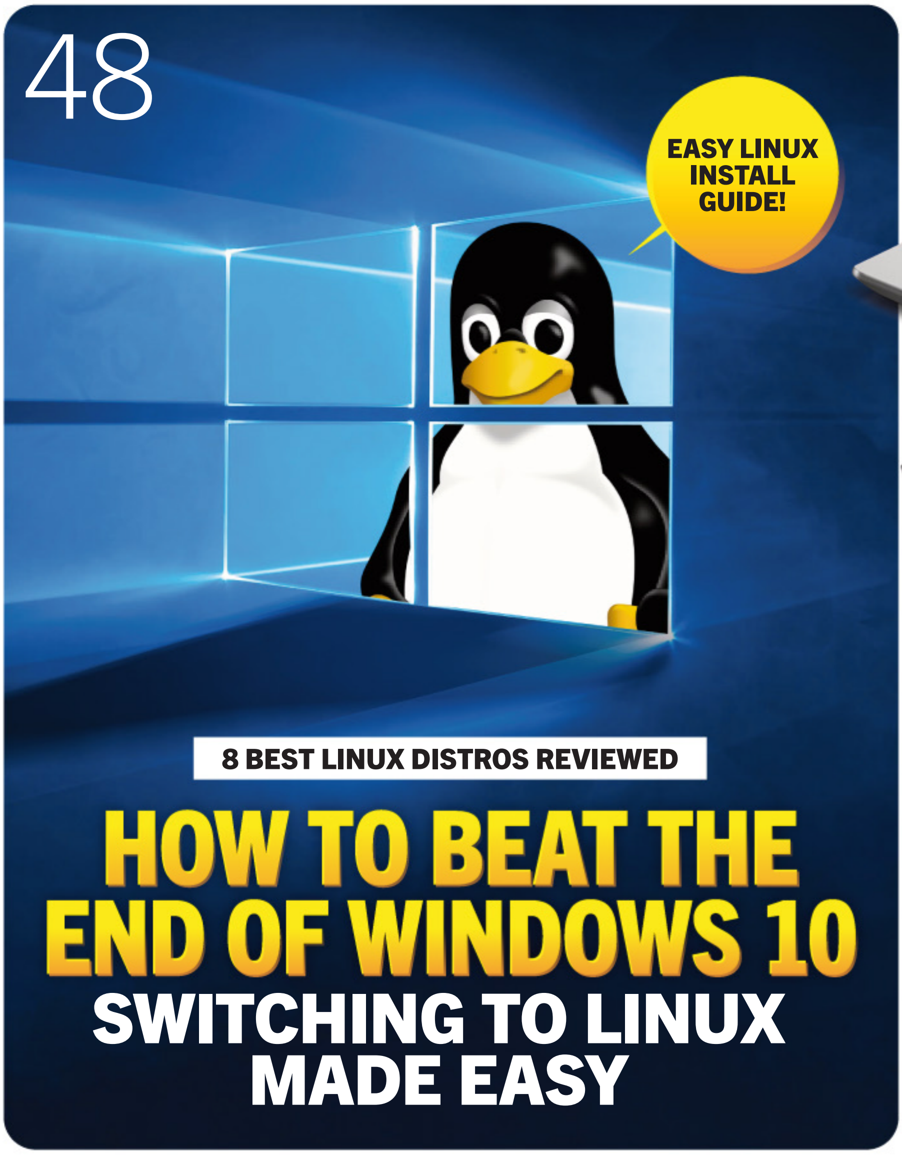

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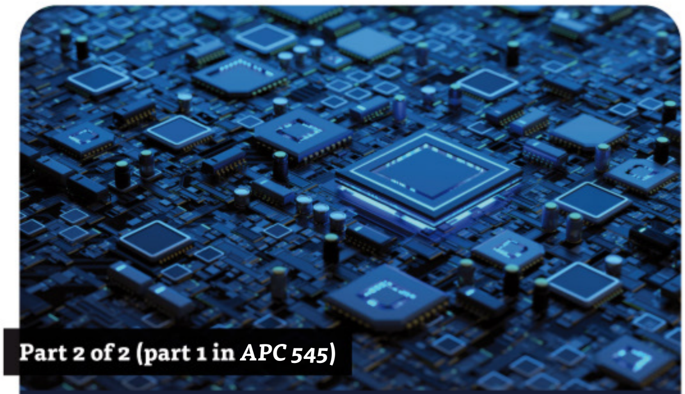

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With our guide to the best NAS devices currently available, you can take control of your files and run your own private cloud.

42 **CPUs the latest generation**
Darien Graham-Smith breaks down all the latest chips from the big three CPU firms – and shares what we know about what's coming next.

> **"Of course, the whole matter is ludicrous. It's even more mad when you consider that the USA simply doesn't have the engineering talent and capacity to make this happen."**

Jon Honeyball - **One more thing**
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TECHNOTES

Everything you need to know from the month in tech

Microsoft finally retires Skype after 22 years

ENCOURAGES USERS TO SHIFT TO MICROSOFT TEAMS.

Microsoft is finally closing the chapter on Skype. Existing users have been asked to switch to Microsoft Teams, and a data migration window will remain open until January 2026. Microsoft says this decision aligns with its strategy to streamline its communication services and focus primarily on Microsoft Teams.

The first public beta for Skype went live in August 2003 and enabled users to call from one PC to another, which was revolutionary at the time. The service further evolved in the following years, with the launch of SkypeOut for traditional landline calls and the introduction of video chatting. This helped grow the platform to 40 million registered users by late 2005. Skype boasted over 405 million registered users by 2008.

Apple is reportedly going all in on smart glasses

YOU'LL BE WAITING FOR A BIT, THOUGH.

Amid reports that Apple CEO Tim Cook is “obsessed” with developing a pair of Apple Glasses, the rumour mill has been rife with claims that Apple's version of smart glasses would feature Apple Intelligence. *Bloomberg*'s Mark Gurman reported that the Cupertino company is develop new chips to power future smart glasses, Macs and AI servers. What's more, the chip meant for Apple Glasses is apparently well on the way.

The alleged glasses SoC is based on the S chip used in the Apple Watch, which requires less energy than the A and M processors used in iPhones and Macs, respectively. Gurman claims this new chip has been customised to be more power efficient while also controlling multiple cameras that the glasses would feature.

Microsoft will soon allow AI to change your Windows 11 settings

Making Windows 11 even richer with AI features.

Microsoft is adding even more AI to Windows 11 courtesy of a new agent that can assist users in the settings app. Microsoft announced in a Windows Experience blog post that the new AI assistant will be capable of adjusting user settings on request, including adjusting mouse precision and asking questions on how to perform specific tasks.

Once it arrives, the new AI agent will be able to assist users in troubleshooting their PC and answer any questions about settings users need help adjusting. The new AI bot, which will be accessible at the top of the Settings app's window bar, can also adjust settings entirely on its own with the user's permission.

Microsoft's upcoming AI agent will first debut via the Windows Insider program for testers using Snapdragon-powered Copilot+ PCs, but will soon come to Windows Insiders on regular x86-powered systems. Microsoft neglected to share a release date for an official update that will make the AI agent accessible to all Windows 11 users.

Microsoft also announced several additional updates in its blog post, some of which are also AI-related. The Photos app is getting new dynamic lighting controls on Copilot+ PCs to assist photo editors. Three light sources can be manipulated in the Photo app, enabling users to adjust the lighting experience of their photos.

The Snipping Tool is also getting an update to adjust the cropping area to frame on-screen content accurately and tightly. This improvement aims to speed up the capture of high-quality crops, with less time needed to fine-tune the image after manually capturing it. Snipping Tool also gets a text extractor that allows users to extract text from photos and screenshots, as well as a colour picker that can capture the exact colour values of anything on the screen.

Copilot itself is also getting a big update in the future, dubbed Copilot Vision, that will enable users to share browsers and app windows with Copilot. This will give Copilot more capability to help users solve problems or provide assistance in websites or applications by giving Copilot full eyes on the physical app itself for analysis.

Microsoft, Shutterstock

Intel is still releasing updates for problems with its 13th and 14th Gen CPUs

THESE BUGS REFUSE TO BE SQUASHED...

Intel is also still working at completely fixing all the problems those chips have had since launch. The results are a new microcode update which comes over six months since the last patch was released in September.

But here we are in mid-2025 and Intel has yet another patch for the well publicised stability issues that plagued 13th and 14th Gen Raptor Lake CPUs. The new microcode fix – dubbed 0x12F and not to be confused with the 0x125, 0x129 and 0x12B patches that came before it – "further improves system conditions that can potentially contribute to Vmin Shift Instability on Intel Core 13th and 14th Gen desktop-powered systems."

Intel is at pains to point out that this new microcode does not imply a change in its analysis of the actual cause of the problems. "The release of the 0x12F microcode does not alter the root cause determination for the Intel Core 13th and 14th Gen desktop processor Vmin Shift Instability issue," Intel says. Multiple factors were causing the chips to run excess voltage and power levels.

Developer gets Linux running inside Microsoft Excel

"MOSTLY FOR FUN" – HOLY SHEET!

Developer NSG650 has succeeded in his attempt to get "Linux running in Excel." The GitHub-hosted and aptly named LinuxInExcel project was uploaded to the cloud-based developer platform in May.

Getting Linux to run within the confines of Excel is the latest in a long line of Excel coding gymnastics, which might only be rivalled by those boasting of running various incongruous software gems inside PDFs. And yes, we have already seen Linux running inside a PDF.

Using this emulation layer and software vector to run Linux takes a toll on performance – and stability doesn't seem to be the best, either. NSG650 confirms LinuxInExcel is "very buggy," but seems to be happy enough with achieving the software milestone, as it stands. It was "done mostly for fun," says the Bangaluru-based developer in the GitHub readme.

Commodore OS Vision 3.0 arrives to spruce up retro builds

FAN-MADE LINUX-BASED OS FOR COMMODORE-BRANDED DEVICES.

Fans of retro computing rejoice! Commodore OS Vision 3.0 has officially been released and is ready to install on your Commodore 64x today. This fan-made Linux-based operating system is designed specifically for Commodore branded devices – particularly ones found through websites like *My Retro Computer*, which have recreated the old school experience of computing by putting modern PC hardware inside retro cases.

The new OS version debuted earlier this week and is backed with plenty of tools and resources to help bring the old school experience back for a modern age. It has a variety of new things like games and even tools that can be used to develop custom apps from scratch.

Intel stealthily pulls the plug on Deep Link

LESS THAN FIVE YEARS AFTER LAUNCH.

Intel has discontinued support for its Deep Link suite of technologies. After Intel quietly stopped promoting the feature in newer products such as Battlemage, it has now confirmed that active development for Deep Link has ceased. While you still might be able to use Deep Link, Intel has clarified that there will be no future updates or official support from their customer service channels.

Deep Link was introduced in late 2020. It allows you to harness the combined power of your Intel CPU and Arc GPU to improve streaming, AI acceleration, and overall efficiency. To utilise Deep Link, you needed an Intel 11th, 12th, or 13th Generation CPU and a dedicated Arc Alchemist GPU. The suite offered four key utilities: Dynamic Power Share, Stream Assist, Hyper Encode, and Hyper Compute.

Shutterstock, Intel

Google is shedding tens of millions of users

Search algorithm changes prioritising reddit and AI answers could be driving users to check out Microsoft's oft-derided search engine instead.

Bing has long been the butt of many 'a joke over the years, owing to direct comparisons with Google. Google search has long held dominance over the web, powering the vast majority of web-based businesses with its online ads platform and algorithmic content curation. Although, the latest data trends suggest that users are starting to look for real alternatives.

Data from both Statista and and StatCounter show a Google in decline. Both platforms use differing methodologies for tallying market share, but StatCounter in particular offered something of an ill milestone for Google. StatCounter showed that Google had dipped below 90% market share this year, for the first time since its records began.

Statista has more granular data, offering Bing a very generous-looking upwards trend if you chart out the past ten years. Other search engines like Ecosia and DuckDuckGo have also seen some potent growth as well. But why is this happening?

It's unlikely to be any single thing impacting Google here, but we can explore some anecdotal possibilities as to what exactly is going on here.

- Google lost anti-trust cases relating to search, forcing it to offer users alternative search engines like Bing during the set up process on Android in some markets.
- Google has been flooding its search results with AI-generated content and reddit posts that often lack context. Gemini's inability to understand context has created a raft of hilarious memes mocking Google search.
- The rise of "ethical" search engines like Ecosia and DuckDuckGo have also given users a real alternative.
- Anecdotally, we've noticed an upswing in interest in Bing via Microsoft Rewards, which gives users points simply for entering search queries, which can then be exchanged for vouchers.
- European alternatives, such as Ecosia, may be seeing growth as countries impacted by Trump's tariff blitz campaign to reject American products. McDonalds recently suggested, for example, that it is seeing decreased sales in Europe due to anti-American sentiment. Could this be impacting Google too?
- Thanks perhaps in part to ChatGPT and Copilot, Bing Search is actually now offering the kind of quality standard Google previously set.
- General AI pollution on the web may be compelling users to break their Google habits to seek alternatives, subsequently discovering that other options aren't half bad.

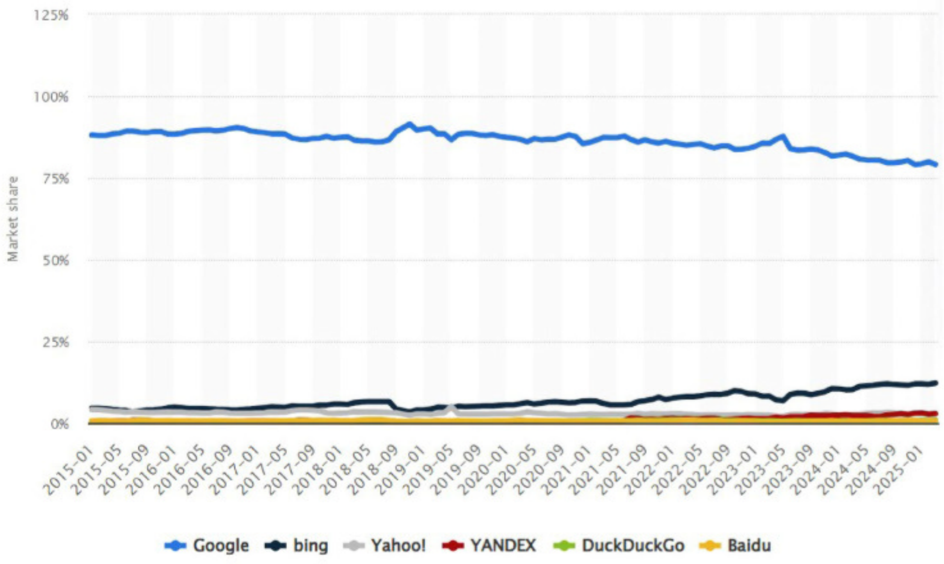
Google still has upwards of 89.9% of global search engine market share, but a drop of a single point accounts for tens of millions of users, given that its overall user base accounts for roughly 5 billion people.

Windows' dominating market share has been overlooked in recent years due to the fact it is a fully open platform. Google, conversely, has been accused of using its monopoly over search to further promote its own products and services while undermining competitors – according to some anti-trust prosecutors at least.

Indeed, regulatory scrutiny of Google is ramping up, with U.S. anti-trust cases calling for the firm to spin off Google Chrome, Android, or perhaps even both.

It seems unlikely that Bing or any other search engine may challenge Google's dominating position any time soon, but if the downward trend continues, it could present Microsoft Bing with an utterly rare opportunity. ■

Statista suggests that Google and Bing are on inverse trends right now, with Bing gradually munching into Google's search share.



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SAPPHIRE

AMD RADEON RX 9070 XT | AMD RADEON RX 9070

SAPPHIRE NITRO+

Does Nvidia not love us anymore?

Nvidia drops the ball into a deep dark black well.

Since the launch of its Blackwell-powered RTX 50 series there has been problem after problem with the new cards, even culminating in issues crossing over into RTX 40 series products. It started off poorly with the world-wide launch providing a relatively insignificant number of cards to retailers for sale, resulting in scalping and ultimately price hikes. Nvidia's early withdrawal of new RTX 40 series cards exacerbated the issue, stemming from the premature RTX 40 series launch that clashed with RTX 30 series stock, leading to competitive pricing problems. This overcorrection for the RTX 50 series has caused a temporary gap in the supply of new cards and created more demand than usual for a new series.

No competition in the high end has also led to the RTX 5080 – and especially the RTX 5090 – being in high demand and causing prices in excess of $6,000 for the RTX 5090. The sceptical will say Nvidia was prioritising its silicon towards AI focused products, and so didn't leave much allocation for the consumer products. It could also have simply been a sales forecast miscalculation, but either way it doesn't excuse the quality issues of the RTX 50 series. A couple were hardware related, but the majority have been software/driver-based issues.

The first hardware related issue is of course the ongoing 12VHPWR connector issues related to connectors burning out and melting. Despite two to three years of constant reported failures, Nvidia continues to use these connectors with electrically poor implementations mandated.

The second hardware issue was that various RTX 5090, 5080 and 5070 cards were produced and cleared quality assurance checks with missing ROPs, being crucial units in the final stages of the rendering pipeline. With around 4% of ROPs missing, depending on the game and settings it could result in between a 5% to 10% loss in performance. Thankfully the number of these examples remains extremely low.

The larger and more complex issue for Nvidia however are the drivers. Usually Nvidia's strong suit, this generation has been a disaster for Nvidia. With a long list of issues including but not limited to: Black screen on Windows boot; Grey screen crashes with multiple monitors; Game freezes and crashes in many titles; GPU temperature sensor monitoring bugs causing incorrect clock speeds; GPU idle clock speed issues; V-Sync Micro stuttering; Blue Screens of Death; Shadow and texture flickering and corruption in several titles; Display flickering with high refresh rates; Blank screens with Display Port 2.1 mode with HDR; Screen tearing issues; problems waking up from sleep mode and finally the quiet and unannounced deprecation of PhysX 32-bit support, breaking many older game titles.

The hit to the brand all these issues is diabolical from a PR perspective. You could argue Nvidia doesn't really need the gaming segment any more, with its latest financials showing that data centre (including AI) related products now accounts for over 90% of Nvidia's total revenue! Gaming with less than 7% doesn't seem like much, but it is Nvidia's second largest revenue stream so while it's riding high on AI currently, it can't remove it entirely purely for diversification reasons.

Given how much of its profit comes from AI though, the brain drain on the consumer gaming software side of things has become apparent and is a serious issue Nvidia needs to address. ■

Mark Williams is an IT professional with a strong interest in voiding warranties.

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FUTURE

Nintendo Switch 2 will probably outsell the Steam Deck

Nintendo doesn't want you to play around with your device; Valve basically invites it, writes Shaun Prescott.

A couple of weeks ago a heated discourse broke out in the office on a matter of grave importance: why would anyone be excited about the Nintendo Switch 2 when the Steam Deck is sitting right there? As an advocate, I guess, for Valve's device, I can accept that Nintendo will outsell the Steam Deck easily, and probably within hours: it has the brand power, a reputation for building hardware that even children can use, and, well, *Mario* and *Zelda*.

All important factors, and I don't think the Steam Deck is going to materially affect Nintendo's dominance of the handheld market – not straight away and probably not for years (if ever). That's not to say it shouldn't, though, and my conviction that the Steam Deck offers a better handheld experience in 2025 has only been reinforced by an egregiously anti-consumer update to Nintendo's online user agreement for the United States, which legally allows the company to basically remotely destroy your Nintendo Switch if you break the rules. "You acknowledge that if you fail to comply with the foregoing restrictions Nintendo may render the Nintendo Account Services and/or the applicable Nintendo device permanently unusable in whole or in part." This amendment hasn't been made to the Australian Nintendo Account Agreement.

What kind of user behaviour could lead to your device being "permanently unusable"? Ah, you know, a lot of stuff that you're basically invited to do with the new wave of PC handhelds. We are not permitted to "Publish, copy, modify, reverse engineer, lease, rent, decompile, disassemble, distribute, offer for sale, or create derivative works of any portion of the Nintendo Account Services."

Console makers have always been strict about what people can use their devices for. Sony and Microsoft – though the latter, marginally less so than the competition – take pains to maintain the "walled garden" approach of consoles, because that is actually what has been attractive about them for a long time. People buy them because they're locked into a network impervious to the inscrutable errors and hi-jacking potential of PCs. They're just gaming machines: great.

Still, that hasn't stopped a dedicated few from unlocking tied-down consoles towards other ends, whether to use them for software now in the official eco-system, or to mod them. Sony has long issued title updates to patch up these circumventions, but dedicated users will always find older firmware for their purposes. Sony doesn't like it, but you can nevertheless do it anyway if you want.

But Nintendo reserves the right, in the US, to not only to cancel your Nintendo Account if you do the "wrong" thing – a right also reserved by Sony and Microsoft in their respective EULAs – but to brick your device, ie, render "permanently unusable" a device you spent $699 on and can now no longer onsell.

One of the benefits of the new PC handheld market is that they're exactly that: PC handhelds. Sure, a Steam Deck can be used like a games console – you can use one without tinkering at all – but it's really the technology you're buying, with which you can do as you see fit. During a time when walled gardens in gaming are coming down, it's becoming increasingly difficult to justify buying into these eco-systems when so many attractive alternatives are at hand. Sure, Nintendo has *Mario*, but that may not mean a great deal in ten years time. ■

> "I don't think the Steam Deck is going to materially affect Nintendo's dominance of the handheld market — not straight away and probably not for years (if ever)."

Shaun Prescott is an Australian editor for PC Gamer and GamesRadar, and writes for APC, TechRadar and more.

Sheer absurdity

Don’t start a trade war when you nothing about trade, demands Jon Honeyball.

We are in the centre of a trade war storm the likes of which we have never seen before. President Trump has decided that he knows best, and that international trade can be reduced to a few simple sums in a spreadsheet. I’d suggest using a slide rule, but I suspect log tables are a little beyond him.

Part of this enormous upheaval is the imposition of large tariffs on good exported from China into the USA. Well, that might change by this afternoon, and it has changed several times in the last few days. But let’s just run with the concept of tariffs on imported electronics.

The logic, thin as it might seem, is that by forcing tariffs on the likes of Acer, Apple, Audi and most all other vendors, they will be pushed into moving manufacturing to new sites within the USA, and that would be A Good Thing for American jobs.

The naivety is almost without limit here. Let’s just start with the obvious issues – how long do you think it would take to for Audi to set up a new car plant in USA? To have it operational and ready to deliver new vehicles? Shall we agree that five years is probably being overly optimistic? How long might it take Apple to have a new factory in Portland churning out iPhones? Anyone out there dare to say less than five years? Anybody want to venture a decade?

For the next bit, you will need advanced counting abilities, so it’s time to take off your socks too and rope in your toes. Let’s start with where the parts come from. The components supply infrastructure necessary to feed such a factory staggers the mind, with each one coming from a different part of the world. What’s the point in having an assembly plant in the USA if the parts have to come from existing manufacturers overseas?

Of course, the whole matter is ludicrous. It’s even more mad when you consider that the USA simply doesn’t have the engineering talent and capacity to make this happen. There aren’t the bodies available with the skillsets necessary at any one location for this to be viable.

We know this because moves are already afoot to move manufacturing to America. TSMC, that world leader in chip building, is trying to get a new plant running in Phoenix Arizona. Approximately half of the reported 2,200 employees have been shipped in from Taiwan. They hope to shift the balance to more American employees as these workers gain the necessary skills, but the reality is that they are not skilled enough. It would take a generation to overcome this problem.

Tim Cook, CEO of Apple, made this very clear recently. He explained that Apple manufactures in China not because it is cheap, but because China has large quantities of highly skilled engineers on tap. One vendor told me that if they needed a thousand engineers who were expert in OLED display manufacturer, and needed them at 3am tomorrow morning, there would be no problem at their plant in China. Try doing that in Phoenix. Excuse me while I pull up the sofa and make popcorn. I’ll wait.

So for sure, bring on a trade war with China. But I don’t need a paper chart full of dubious figures to tell you this: he won’t win. ■

> “Of course, the whole matter is ludicrous. It’s even more mad when you consider that the USA simply doesn’t have the engineering talent and capacity to make this happen.”

Jon Honeyball has run his own tech consultancy and product test lab since 1989.

GADGETS

Nice things to have

Acer Predator X32 X2

Although Acer's Predator monitors are chiefly aimed at gamers, there's still a lot else to love about this latest model – the X32 X2. Aside from its striking design, the display features a 31.5-inch Ultra HD (3840x2160 pixel resolution) QD-OLED panel with 0.03ms response time and 240Hz refresh, making it one of the best performing displays around.

Offering 250cd/m2 brightness and with a 1,500,000:1 contrast ratio, it'll enable you to see clearly into even the darkest corners of your favourite movies and games. Plus it's capable of displaying over 1.07 billion colours and achieves 99% of the DCI-P3 colour gamut, making it handy for photo and video editing too.

On the back you'll find two HDMI 2.1 ports and DisplayPort 1.4, plus speaker and audio ports, and its stand is tilt, swivel and height adjustable, making it a great option for almost anyone.

$TBC | **acer.com**

The Predator X32 X2's stand adjustability is as impressive as its display's brightness and refresh rate credentials.

StationPC PocketCloud

Network-attached storage (NAS) can be a great way to store and back up all those files you don't have room on your device for, but most solutions are decidedly desk-bound. Not so the PocketCloud. Currently discounted on Kickstarter for US$199 (about AUD$312), this portable NAS comes with M.2 NVMe slots enabling you to add up to 16TB of solid-state storage, with its internal battery lasting for up to six hours when in use, or up to 20 days on standby.

US$299 (about $469)
nas.stationpc.com

The PocketCloud's portable aluminium enclosure is shock-proof for life on the go.

Twelve South AirFly Pro 2

Twelve South's Bluetooth audio adaptor has been given a makeover and is now even better than before with longer battery life and a slew of new features. Ideal for use on planes or in any car with a 3.5mm audio jack, the AirFly Pro 2 enables you to connect to other devices wirelessly, including to headphones and to your phone, meaning you can listen to the songs stored on it through your car's head unit. The AirFly Pro 2 now lasts for up to 25 hours between recharges, and has new volume and mute buttons too.

$105 | **twelvesouth.com.au**

Keychron K3 Max

If you like your keyboards to give you more tactile feedback than your current keyboard currently offers, the new K3 Max from Keychron is definitely worth tapping up. The K3 Max features low-profile Gateron MX 2.0 mechanical switches for great typing feel, while the equally low-profile keys are made from double-shot PBT (polybutylene terephthalate), making them long-lasting and oil resistant.

Best of all, the K3 Max keyboard can be programmed, enabling you to remap its keys and create macros. It's also kitted out with Wi-Fi, Bluetooth 5.1 and USB-C.

$161 | **keychron.com**

ESR Qi2 MagSafe Car Charger

Designed to attach either to your car dashboard's air vents or to the dash itself, this Car Charger from ESR is a great way to keep your iPhone juiced up when travelling. Featuring both Qi2 and MagSafe, it provides up to 15W of wireless charging power to your phone via a spare 12v charger socket and can fully charge an iPhone 16 Pro in under two hours, even when you're using battery-sapping satnav. The charger also comes with CyroBoost to help your phone stay cool, while its 18 magnets keep your phone firmly attached.

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FUTURES

We explore the trends and technologies that are set to shape the future

The outlook is sunny for weather apps… thanks to AI

AI-based weather forecasting systems aren't only cheaper than supercomputers, they could also bring more accurate predictions to the world. Nicole Kobie reports on the winds of change.

Look at your weather app and it says rain soon – and then you end up carrying an umbrella in the sunshine. Or, the app predicts sun and you end up drenched. What if weather forecasts were more accurate?

Now imagine you live in a country that doesn't have access to its own weather models and relies on systems designed for other parts of the world. Local storms can't be predicted and seasonal forecasts required for agriculture aren't accurate enough.

There's a solution and, predictably, it's based on AI. Less predictably, it's called Aardvark – an AI-based system that ditches supercomputers and allows local models to be run on a desktop by a single researcher.

The prediction problem

At the moment, weather forecasts are generated in a multipart process using supercomputers. Each section can take several hours to run, and requires large teams of experts to use, develop, maintain and deploy. That means weather prediction is expensive and time-consuming, effectively cutting it off for countries without the means to own and operate supercomputers.

Ghanaian meteorologist Michael Baidu is currently a research fellow at the University of Leeds. "We do not run our own models, mainly because of computational costs and how much power is required to run these models," he said, speaking at the Turing Institute's AI conference.

The challenge is exacerbated by unstable power supplies; if it cuts out part way through a model running, the whole process must begin again. "So we've mainly relied on the global north for the output of the models that we use for forecasts," said Baidu.

That includes the Met Office, the European Centre for Medium-Range Weather Forecasting (ECMWF) and the US National Weather Service. "Those models have mainly been developed for the mid-latitudes and not for tropical latitudes, so they are not able to simulate tropical storms accurately," Baidu explained. "That's one reason why we have a need to get models that run at a higher resolution over Africa that best suit African weather, which is a challenge because of the computational costs involved in running these models."

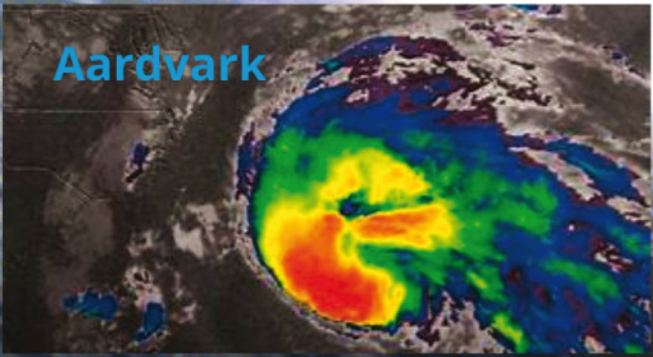
Caroline Bain, head of verification, impacts and post processing at the Met Office, said organisations such as her own are improving model data for parts of Africa, but it's worth supporting countries such as Ghana to build their own systems. "One of the things we're really excited about with AI is there could be more resilience in some of these countries, so they have the opportunity to own some of these models themselves rather than be too dependent on the global producing centres that are generally in the global north," she said at the conference.

Swapping out supercomputers for AI

AI has been applied to individual parts of that supercomputer-dependent process already, notably with research by Huawei, Google and Microsoft, which replaced the numerical solver that calculates weather over time.

Richard Turner, research lead for AI weather prediction at Turing and a

Aardvark
Ground Truth
t = 1 day forecast



TOP The AI-based Aardvark system can be run on local computers.
ABOVE Aardvark pulls in data from a variety of sources to create forecasts.

professor of machine learning at the University of Cambridge, explained that current numerical weather prediction works in three separate stages. First, information is gathered from weather stations, satellites, boats and so on, then run through models to create an estimate of the current state of the atmosphere.

Second, a physical model is run to predict how the atmosphere is going to develop over the next few hours, days or weeks; this is based on physics, notes Bain, with known processes such as shallow water equations and fluid dynamics applied to the information. “This makes predictions everywhere, in a relatively coarse way, around the globe,” added Turner.

In the third stage, known as post processing, those coarse predictions are applied to smaller areas to allow a forecast for a specific location.

AI has been applied to the second step with a lot of success, helped by incredibly clean data sets of weather conditions provided by organisations such as ECMWF. “It’s not like data in other parts of machine learning science, which has privacy concerns attached to it or missing data – it’s incredibly clean and noise-free,” said Turner.

Machine learning researchers took that remarkable data set and used large language models (LLMs) with transformers. These are the same sort of systems that power ChatGPT et al, but here they’re designed for vision and look at historical numerical weather data as though it’s an image. They can then forecast what’s coming next, the same way a text LLM predicts the next word in a sentence.

Fully trained up, Turner said it worked as well as – if not slightly better than – the best numerical systems. “But this doesn’t take a supercomputer to run that step, it takes a few GPUs,” he said, though he admitted training was expensive. “You’re replacing the work of a large team that has to develop these things over many years and maintain them with a supercomputer that’s very expensive, and reducing those costs by a thousand or ten thousand times, which opens up a vista of new opportunities.”

Work continues on this style of AI weather forecasting, with the ECMWF’s strategic lead for machine learning Matthew Chantry saying the organisation was now using such a system to make daily forecasts. This means meteorologists can compare that tool to existing systems to better understand how it works.

An AI solution in Aardvark

That’s one part of the system replaced with AI – but you’ll still need a team of researchers and a supercomputer to manage that first step, taking the collected data and building a model, leaving the wider problem unsolved.

What if you replaced the whole process with AI? That’s what a team of researchers from the University of Cambridge, Alan Turing Institute, Microsoft Research and the ECMWF have managed to do, led by Turner.

They created a single machine learning model called Aardvark Weather that cuts across all three stages, trained end-to-end to take raw data and make forecasts. “If you can do that, then you can run these things on GPUs or desktop computers,” Turner said, and that means countries such as Ghana can not only run their own models, but can make predictions on challenges that specifically impact them.

Building the initial system was no easy task. Simply pulling in the relevant data took two years of a student working with organisations around the world, with the data processed through different types of machine learning.

Once trained, it pulls in weather observations from satellites, weather stations and other sensors to create forecasts in minutes. That means it’s faster and cheaper than existing supercomputer-based systems.

But Aardvark is also more accurate – even using less data. When pulling in only 10% of the data used by existing systems, Aardvark Weather already outperforms the US national GFS forecasting system on some variables, and is comparable to the US Weather Service. “In accuracy, people have estimated that you can get two to three days extra improvement in the efficacy of your forecast, so your forecast at three days will be as good as your forecast at one day

Getting data from Antarctica is a real challenge, but AI can help.

ahead if you can use these new techniques," Turner said.

Douglas Parker, professor of meteorology at the University of Leeds, noted that the limits on accuracy are as yet unclear. "We do know that there [are] some fundamental chaotic limits on how far you can predict the future in our chaotic world, but certainly we are seeing these new models pushing the boundaries beyond what we can currently do," he said.

Access for all

Creating bespoke forecasts using existing systems could take years of work, meaning Aardvark could open up weather tools to countries that previously didn't have access because of the high costs involved.

"Aardvark's breakthrough is not just about speed, it's about access," Dr Scott Hosking, director of science and innovation at the Alan Turing Institute, said in a statement. "By shifting weather prediction from supercomputers to desktop computers, we can democratise forecasting, making these powerful technologies available to developing nations and data-sparse regions around the world."

The simplicity of the system means it can be easily adapted for specialised forecasts for a location or industry – such as wind speeds for a renewables company in Australia, or temperatures for agriculture in Africa.

Indeed, as Parker notes, rather than training with a European or global focus, it can focus on a specific region. "Smaller teams with smaller computers can be creating, delivering and innovating the forecasts themselves," he said. "Designing and training solutions in Africa for Africa – that change is really fundamental."

What's next

Next, the researchers building Aardvark Weather will set up a team within the Alan Turing Institute specifically to figure out how to get the system into use in developing countries and to apply it to a wider range of environmental conditions.

"These results are just the beginning of what Aardvark can achieve," said Anna Allen, lead author from the University of Cambridge. "This end-to-end learning approach can be easily applied to other weather forecasting problems, for example hurricanes, wildfires and tornadoes. Beyond weather, its applications extend to broader Earth system forecasting, including air quality, ocean dynamics and sea ice prediction."

Beyond Aardvark Weather, the growing accessibility of weather forecasting means the market is opening up to private companies rather than just national government organisations, says Parker. "The private sector has been very active," he said, adding that it's no longer huge companies but SMEs, too. "I don't present that as good or bad, it's just this is the state of how things are changing. The next two or three years, we're really going to see the implications of that."

And the winds of change are certainly blowing. As Turner notes, weather forecasting has been relatively static for decades, but in the past three years it has been completely transformed by AI. "There are incredible opportunities across the whole of Earth systems forecasting as a result," he said. ■

AI for polar frontiers

With climate change in mind, we need to know what's happening to polar regions. Is the ice receding? What's the weather like, beyond freezing beyond all comprehension? How are marine environments changing?

As we've seen with weather forecasting, AI can sift through data to make the necessary predictions to track the damage we've done to polar ice. But first we need to get the data.

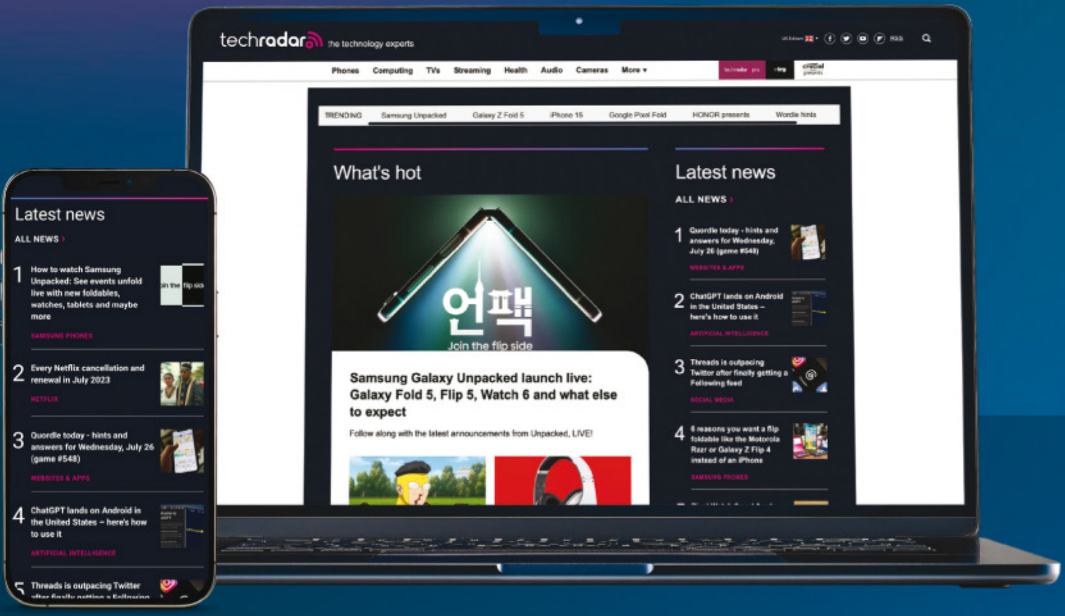
James Byrne, research software engineer lead at the British Antarctic Survey (BAS), said the trick is getting data out of a very hostile environment. "It's a lot of fun working down there, but you don't have mobile networks, it's done by satellite or going to get an SD card out of an instrument that just overwintered in minus 50 conditions in blowing snow all year round – so that data becomes extremely valuable," he said.

BAS uses AI to examine how to improve operations so they're less carbon-intensive, but also to help fill in missing data – it's impossible to get it all in such conditions.

But once we have it, we can apply it to better understanding that environment. Louisa Van Zeeland, research lead at Turing, works on IceNet, which forecasts sea ice with 95% accuracy two months out. "In IceNet, we have three data sets combined together into a unit source and into the model," she said. "What I want to do is look at all these data sources, how do we find a probabilistic way to combine them going through multiple AI models that chooses the best way forward."

Edward Steele, science manager for marine applications at the Met Office, notes that bringing together multiple data sources to improve decisions is one of the most undervalued uses of AI – not just lowering costs, speeding up calculations or otherwise improving efficiency. And that's especially true when working in a region where data is tough to come by.

Meet the technology experts



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You will see this award if a reviewed product has scored four out of five stars. It means most people can expect satisfying performance from the product, and that we would use it ourselves.

PRICE $1,099 **WEB** https://www.synology.com/en-au

Synology DiskStation DS925+ NAS

Once again, Synology's new four-bay NAS comes with controversy. But, is it still the one to buy?

apc
EDITOR'S CHOICE
STATUS
DISK 1
DISK 2
DISK 3
DISK 4
Synology
DS925+

Synology's DiskStation DS925+ is the latest version of its sweet-spot 'four-bay' NAS which is popular for beginners, smart-home enthusiasts and SMBs who want the potential storage capacity afforded by four 20TB mechanical drives and two 800GB SSDs. Those limits reflect the current, maximum drive size that Synology sells, with the controversy coming from its locking out of all (cheaper) third-party alternatives. Strict, new certification processes may eventuate limited alternatives down the line, but Synology is blunt about its ruthless justification – it was sick of interminable support calls where users and third-party vendors blamed Synology for failures that Synology blamed on other people's drives.

A five-bay expansion unit can be added via a new USB-C port which replaces the eSATA seen on forebears. There are front-and-rear USB-C 3.2 Gen 1 ports (for external drives) but these have been locked-down in terms of versatility: print server and network dongle functionality has been deprecated for security reasons.

Inside, there's a more-powerful, quad-core, AMD Ryzen V1500B processor and one if its two SODIMM slots arrives populated by a 4GB stick of ECC RAM. Up to 32GB is supported.

The two Ethernet ports have (finally) been upgraded to 2.5GbE speeds. However, the slot for an optional 10GbE port has been removed which will urk some users.

Set-up is simple thanks to Synology's mature and intuitive tool-less design. You open the 'lockable' drive-bays doors, slide out the trays, clip-in the drives (rubber grommets reduce vibrations) and slide them back in. Two SSDs can easily clip into slots in the base. We then ran Synology's NAS-locator app, watched the DSM operating system automatically install and were up and running in 15 minutes.

While the vendor-locked hardware comes at a hefty premium, the software that comes with DSM potentially makes for incredible value – if you use it. There are well-polished, bespoke apps for smart-homes, like photo management and domestic back-up. There are popular third-party media apps like Plex, Jellyfin and Emby, and much more. The business-grade apps are fit to run an enterprise and come with free licenses for multiple users. They include top-tier onsite, off-site and cloud backup, network-security tools, virtual machine management, web and email servers, security camera management and there's even a full, Synology Office suite. It's all free.

I compared performance against our 10GbE-connected DS723+ (with newly fitted NVMe drive). Over Wi-Fi 7 it achieved 244MB/s using mechanical drives and a colossal 347MB/s using the SSD. The DS925+ bottlenecked at 283MB/s for both mechanical and SSDs. Bonding the ports into a single, 5GbE (load balancing) connection made it slower. Few will be affected, but it's worth stressing that NVMe drives on the DS925+ are only good for caching and complex onboard tasks that benefit from a (stated) 15x increase in IOPs.

Throughout testing the DS925+'s twin, 92mm fans remained very quiet and the drives' pops and clicks were barely perceptible.

Casual NAS users will find better value elsewhere. However, access to the vast, polished and professional Synology ecosystem will more-than justify the high price to buyers who make use of it. ■

SPECS 2.2GHz quad-core Ryzen V1500B CPU, 4GB DDR4 ECC RAM (expandable to 32GB). 4 x lockable 3.5-inch drive bays, 2 x NVMe M.2 drive bays, 1 x USB-C 3.2 Gen 1 (for expansion unit), 2 x USB-A 3.2 Gen 1, 2 x 2.5Gb Ethernet ports, Synology DiskStation Manager operating system.

VERDICT

★★★★★

Some contentious design choices don't stop the DS925+ from being the best four-bay NAS on the market.

Nick Ross

PRICE $TBA **WEB** hp.com

HP ZBook Ultra G1a

A business laptop with gaming-grade performance.

The HP ZBook Ultra G1a is the first laptop through our Labs that uses the new AMD Ryzen AI Max Pro 390 CPU (details on facing page), which also includes the impressive Radeon 8050S iGPU. But the G1a is more than just a great CPU, and includes up to 128GB of LPDDR5X-8533 RAM (which is shared as VRAM), and as much as 4TB of storage, helping it stand out compared to typical business laptops.

The laptop itself is fairly unassuming looking. It's not the thinnest, or the most stylish. But it's solid, feels very robust, and comes with all the features you'd need. Our test unit has a 14in 1920 x 1200 display (400 nit, 100% sRGB), but there's also a 2.8K (2880 x 1800), 120Hz OLED option, with or with out touchscreen. The laptop is also equipped with the latest Wi-Fi 7 and Bluetooth 5.4, as well as an NFC card reader.

Performance from the Max Pro 390 CPU is outstanding, and in multithreaded benchmarks, it happily bests any other mobile CPU we have tested. While slightly slower than competing Intel CPUs in single-core tests, it makes up for it with the best iGPU available, which means it can handle very heavy workloads. The Radeon 8050S is also quite capable for gaming, and happily averaged 63 FPS in *Cyberpunk 2077*, with ray tracing enabled.

While the G1a can be purchased with up to 128GB of RAM, it's worth noting that this is soldered on, so can't be upgraded later.

The processor also features an NPU, with 50 TOPS of performance, which enables Windows Copilot+ and will become increasingly useful for AI-enhanced workflows in the future. Just as impressively, the cooling system in the G1a manages to dump the heat generated by the CPU and iGPU without the laptop getting too hot – even under extended load we saw a maximum temp of 40°C for the keyboard, vents and underside.

The G1a has a decently sized 74.5Wh battery, which can go from flat to 50% in just 30 minutes using the 140W (28V, 5A) USB-C charger. Battery life depends on workload, but it lasts 12 hours, 48 minutes on the PCMark Modern Office battery life test, and a touch over 13 hours for video playback.

The G1a has a robust build quality and feels tough, though it's a little chunkier than slim laptops at 1.85cm thick. The backlit keyboard and trackpad reflect the premium nature of the G1a, and are comfortable to use for long sessions. Despite the lower resolution, the screen is very good, and folds back through ~140 degrees, so the laptop can be stood almost vertical on a stand.

Audio from the speakers is the typical usable but slightly tinny affair, while the facial recognition webcam is excellent and enables extra HP security features, like screen blurring if you are not looking at the laptop. On the left, the laptop has dual USB-C ports (1x Thunderbolt 4, 1x 10Gbps), HDMI and a 3.5mm jack, and USB-C (Thunderbolt 4) and 10Gbps USB-A on the right side. All USB-C ports support charging and video output, and about the only thing we could wish for is a microSD card reader. ■

BENCHMARK RESULTS	HP ZBook Ultra G1a	MSI Prestige 16 AI Evo B2HMG
CPU	AMD Ryzen AI Max Pro 390	Intel Ultra 9 285H
GPU	Radeon 8050S	Intel Arc 140T
Battery Capacity	74.5 Wh	99.9Wh
RRP	N/A	$3,499
PCMark 10	7,722	7,810
Cinebench R24 - CPU (multi-threaded)	1,197	941
Cinebench R24 - CPU (single-threaded)	108	127
Geekbench 6 - Multi-core (score)	16,371	15,848
Geekbench 6 - Single-core (score)	2,826	2,925
Geekbench 6 - GPU (score)	71,177	41,776
3DMark Time Spy	9,298	4,443
3DMark Night Raid	52,132	34,598
Battery life - 1080p video playback (h:min)	13:03	19:58
CrystalDiskMark Read (MB/s)	7,107	6,986
CrystalDiskMark Write (MB/s)	5,137	5,785

SPECS W11 Home; 14in, WUXGA (1920 x 1200) IPS; AMD Ryzen AI Max Pro 390 CPU, Radeon 8050S iGPU; 32GB LPDDR5X RAM; 1TB SSD; 74.5Wh battery (12h 48m PCMark10 Work); 31.22 x 21.55 x 1.85 cm; 1.5kg

VERDICT

★★★★☆

A compact yet very powerful business laptop that stands out thanks to the powerful AMD CPU and iGPU.

Lindsay Handmer

EXPLAINER

Unleashing mobile performance

AMD's Ryzen AI Max Pro 300 Series and Radeon 8000S graphics.

Launched at CES 2025 and only just now hitting Australian shores, the Ryzen AI Max Pro 300 Series is a high-performance processor family specifically designed for use in demanding mobile applications. The new CPUs include the Ryzen AI Max Pro 385, Ryzen AI Max Pro 390 and Ryzen AI Max+ Pro 395, which are (mostly) more powerful than the Ryzen AI 9 HX Pro models launched last year.

Built using AMD's Zen 5 architecture, the new CPUs in the 300 series offer a range of configs with 8, 12 and 16 cores, (and double that for thread count), with boost clocks up to 5.1GHz, and L2+L3 cache up to 64MB.

Like the Ryzen AI 9 HX Pro lineup, the new processors use TSMC's 4nm FinFET process for better power efficiency, and have configurable TDPs that range from 45W up to 120W. This means the Ryzen AI Max Pro 300 series can be used across various laptop designs, from thinner, more portable models, through to very high-performance workstations.

Like Zen 4, the Zen 5 architecture includes full support for AVX-512 instructions, for better performance in workloads like machine learning, AI and multimedia processing. The CPUs also feature a powerful new integrated GPU – the Radeon 8040S, 8050S and 8060S.

As with the older AMD 300 Series CPUs, the new models have a XDNA 2 Neural Processing Unit (NPU), capable of delivering up to 50 TOPS of AI compute. The NPU is built to efficiently handle on-device acceleration, supporting AI-enhanced workflows like Windows Copilot+ without burdening the CPU or GPU. While right now there are not many applications that take full advantage of the NPU, one of the most important aspects is that it offers very efficient handling of machine learning tasks, which better supports certain demanding workflows without monopolising the CPU and GPU, and helping extend run time when on battery.

We got hands on with the AMD Ryzen AI Max Pro 390 (12 cores, 24 thread, boost clock up to 5.0 GHz) in the HP ZBook Ultra G1a, so check out the review for more performance figures. But suffice to say it's a very impressive CPU, with excellent multithreaded and graphics performance that easily outclasses the competition.

Radeon 8000S series iGPUs: High performance integrated graphics

The Radeon 8000S series included in the Ryzen AI Max Pro CPUs use AMD's RDNA 3.5 architecture and has three models: the RX 8040S, 8050S, and 8060S. All three use a unified memory architecture, dynamically accessing LPDDR5X-8000 system RAM as VRAM, and can use up to 128GB. The iGPUs include 32MB of MALL (Memory Access Last Level) cache that improves performance by storing frequently accessed data closer to the GPU. They also support AV1 encoding and decoding, along with AMD's FidelityFX Super Resolution (FSR) for better gaming performance.

So what models are in the Radeon 8000S series lineup? At the lower end, the 8040S has 16 Compute Units (CUs) humming along at 2.8GHz, and is aimed at basic productivity, multimedia, and light gaming. The 8050S doubles those specs to 32 CUs at the same clock speeds, and is designed to handle tasks like 3D rendering. It's also quite capable for gaming at 1080p, as it supports hardware-accelerated ray tracing and is compatible with DirectX 12 Ultimate, DisplayPort 2.1, and HDMI 2.1.

The 8060S leads the pack with 40 CUs and a slightly higher 2.9GHz clock speed, and manages performance that can beat out other iGPUs and even rival entry-to-mid-range discrete GPUs. This means it's well suited to 1080P+ gaming, content creation, and demanding professional workloads.

Lindsay Handmer

> "Built using AMD's Zen 5 architecture, the new CPUs in the 300 series offer a range of configs with 8, 12 and 16 cores."

CPU Model	Cores/Threads	Threads	Base Clock	Boost Clock	Total Cache	TDP Range	iGPU
Ryzen AI Max Pro 385	8	16	3.6GHz	5.0GHz	40MB	45W-120W	Radeon 8050S
Ryzen AI Max Pro 390	12	24	3.2GHz	5.0GHz	76MB	45W-120W	Radeon 8050S
Ryzen AI Max+ Pro 395	16	32	3.0GHz	5.1GHz	80MB	45W-120W	Radeon 8060S

GPU Model	Compute Units (CUs)	Shading Units	Ray Tracing Cores	Texture Mapping Units	ROPs	Clock Speed	TFLOPs
Radeon 8040S	16 CUs	1,024	16	64	32	2.8 GHz	11.5
Radeon 8050S	32 CUs	2,048	32	128	64	2.8 GHz	22.9
Radeon 8060S	40 CUs	2,560	40	160	64	2.9 GHz	29.7

PRICE $949 **WEB** msi.com

MSI GeForce RTX 5060 Ti 16G Gaming Trio OC

A factory overclocked GPU with great performance, but is it worth the price tag?

SPECS 4,608 CUDA cores; 2,647MHz boost clock; 16GB GDDR7 28Gbps memory, 448GB/s memory bandwidth; 3x DisplayPort 2.1b, 1x HDMI 2.1b; 180W TDP; 3-year warranty.

BENCHMARK RESULTS	MSI GeForce RTX 5060 Ti 16G Gaming Trio OC	Asus Prime GeForce RTX 5060 Ti 16GB OC Edition
Synthetic Benchmarks		
3DMark Time Spy Extreme	7,419	7,325
3DMark Fire Strike Ultra	9,987	9,900
3DMark Steel Nomad	3,960	3,846
3DMark Speed Way	4,312	4,431
3DMark Port Royal	10,363	10,123
Ultra Ray Tracing, balanced scaling		
Cyberpunk 2077 - 1080p	67	68
Cyberpunk 2077 - 1440p	45	45
Cyberpunk 2077 - 4K	35	37
Cyberpunk 2077 - 4K DLSS 4	74	72
Ray Tracing, Cincematic, 50% upscaling		
Black Myth: Wukong - 1080p	47	46
Black Myth: Wukong - 1440p	33	32
Black Myth: Wukong - 4K	22	23
F1 23 - 1080p	88	84
F1 23 - 1440p	66	63
F1 23 - 4K	39	39
Shadow of the Tomb Raider - 1080p	87	89
Shadow of the Tomb Raider - 1440p	81	79
Shadow of the Tomb Raider - 4K	55	54
Warhammer III - 1080p	106	101
Warhammer III - 1440p	56	55
Warhammer III - 4K	33	33
Compute testing		
GeekBench 6 Compute (OpenGL)	139,562	139,214
Blender (aggregate score)	1,426	1,401
Thermals (°C)		
Peak GPU temp	63	62
Idle temp	35	32

The MSI GeForce RTX 5060 Ti 16G Gaming Trio OC uses Nvidia's Blackwell architecture, with 4,608 CUDA cores, and an overclocked boost clock of 2,647 MHz – up from the stock 2,570 MHz. If you install MSI Center, that boost clock can be pushed a little further to 2,662 MHz using Extreme Performance mode. The card comes equipped with 16GB of high-speed GDDR7 memory running at 28 Gbps on a 128-bit interface, so is well suited to tackle 1440p and even 4K gaming.

The 5060 Ti uses 8x PCIe 5.0 bandwidth, but still physically needs a full length 16x slot. Power is supplied via a single 16-pin connector, and there is a dual 8-pin to 16-pin adapter included in the box. MSI recommends using a 600W PSU to ensure the card gets enough power, as it can draw up to 180W.

The MSI 5060 Ti has a pretty sleek design with subtle but appreciated RGB lighting and (of course), the iconic MSI dragon emblem. It has a chunky metal backplate (with airflow cutouts) to provide structural support, and includes three MSI Stormforce fans with an extra circular rim joining the blade tips to improve airflow. It also has the usual array of heatpipes, and a full length heatsink, plus heat pads on critical components like the VRAM – including the chips on the rear of the card.

The GPU measures in at 300mm – long but not outrageous – and 125mm high and 44mm thick, which is typical 2.5 slot size. We measure it at 848 grams and MSI includes a magnetic, extendable GPU support in the box so you can help take a little load off your motherboard PCIe slot.

The MSI GeForce RTX 5060 Ti 16G GAMING TRIO OC includes three DisplayPort 2.1b outputs and one HDMI 2.1b output, and can drive up to four displays. The DisplayPort outs can handle 4K at 240Hz (or 8K at 165Hz), while the HDMI port supports resolutions up to 4K at a maximum of 480 Hz or 8K at 120 Hz with DSC, VRR (variable refresh rate), and HDR.

Performance from the MSI 5060 Ti is excellent, and it handles higher 1440p and 4K resolutions better than the older 4060 Ti, and while it has better ray tracing performance compared to the RTX 4070, it can fall behind at 4K in some games. Compared to AMD cards, in most cases it's noticeably faster than the Radeon RX 7700XT, but only tends to beat the RX 7800 XT in ray tracing heavy titles.

The MSI cooler does a bang-up job of keeping temps under control, and even flat out, the card is comparatively cool and quiet and we saw a maximum of 63°C. The factory overclock is also appreciated and gives around a 3% boost in performance compared to stock.

The GPU includes a range of handy software, such as MSI Center for real-time system monitoring and performance tuning. Then there's Afterburner – a very well regarded overclocking tool that gives users precise control over aspects like GPU OC settings, fan curves, and voltage adjustments. You also get the innovative MSI App Player – an Android emulator developed in partnership with BlueStacks that lets you use Android apps and play mobile games on your PC.

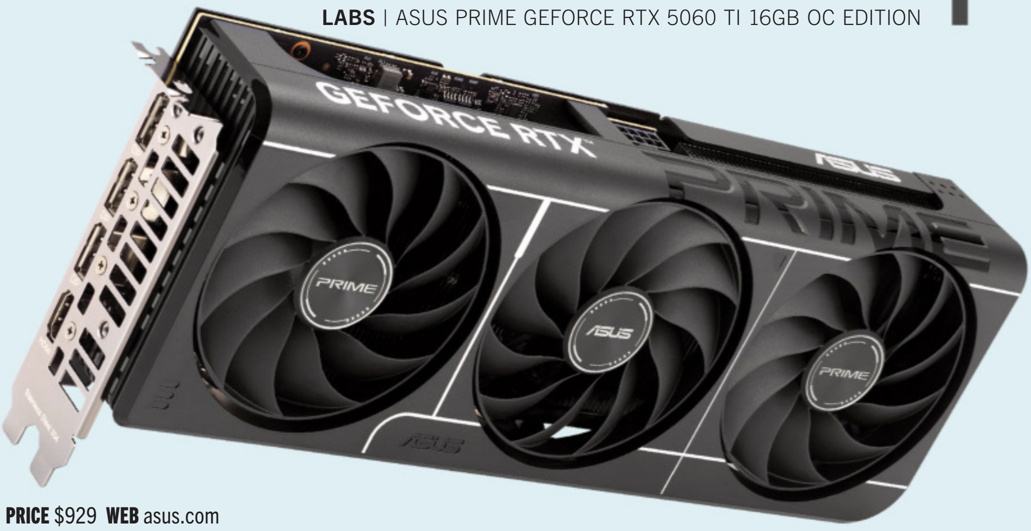
Overall the MSI RTX 5060 Ti is a great card, but for now, prices are at or above the RRP. That means it faces stiff competition from the RTX 5070, which, even with only 12GB of VRAM, offers 30% better performance in many games, yet is only 10% more expensive. ■

VERDICT

★★★⯪☆

Excellent performance and features, but at a price that leaves it struggling to give good value for money.

Lindsay Handmer



PRICE $929 **WEB** asus.com

Asus Prime GeForce RTX 5060 Ti 16GB OC Edition

Compelling mid-range muscle, but not at the current street price.

The Asus Prime GeForce RTX 5060 Ti OC Edition in our Labs is the 16GB version, but be aware there is also an 8GB version available. Built on the same new architecture that underpins the rest of the 5000 series cards, the 5060 sports a factory overclock that takes the boost clock from the stock 2,570 MHz up to 2,617 MHz, and 2,647 MHz in OC mode.

The card uses 8x PCIe 5.0, but needs to plug into a full-length x16 slot. The standard 5060 Ti can draw up to 180W, and Asus recommends pairing it with a 550W PSU, or higher. Despite this lower draw, the Asus boffins have kept clear of the troubled 16-pin power connector, and instead the card has a single standard 8-pin connector.

Design-wise, the Asus Prime 5060 Ti has an almost art deco aesthetic with elegant black curves highlighted with simple white lines, and gasp, no RGB LEDs. The GPU uses a typical triple fan configuration and a 2.5-slot form factor, making it easy to slot into most builds. It has a thick metal backplate to provide extra structural support, and measures 304mm in length, 120mm in height, and 50mm across.

For driving your monitors, the card has three DisplayPort 2.1b outputs and one HDMI 2.1b output, supporting up to four displays in total. The 5060 Ti can output 4K at 240Hz or 8K at 165Hz (using Display Stream Compression), and supports VRR and HDR.

When put through our array of benchmarks, the Asus 5060 Ti delivers the expected excellent results, particularly at 1440p – the GPU's sweet spot. A major upgrade included (compared to older models) is support for DLSS 4 with Multi Frame Generation, which makes it possible to get very playable frame rates at 4K in many titles.

The RTX 5060 Ti outperforms the previous generation RTX 4060 Ti by a solid margin and competes well with the RTX 4070 at 1080p and 1440p. Compared to equivalent GPUs from AMD, the 5060 Ti surpasses the Radeon RX 7700 XT most of the time but can be outpaced by the RX 7800 XT in games without a focus on ray tracing or DLSS 4.

The Asus cooling solution is very effective, and easily maintains temps below 60°C under full load, while also remaining remarkably quiet – especially when the Quiet BIOS mode is activated. Compared to stock, the factory overclock provides a modest performance boost of around 3% but the card can be pushed further without much fuss using the included GPU Tweak III utility.

Overall, the Asus Prime RTX 5060 Ti is a solid performer, but with street prices currently higher than the RRP, it's not much cheaper than the RTX 5070, which offers significantly better performance for only slightly more money. ■

SPECS 4,608 CUDA cores; 2,647MHz boost clock; 16GB GDDR7 28Gbps memory, 448GB/s memory bandwidth; 3x DisplayPort 2.1b, 1x HDMI 2.1b; 180W TDP; 3-year warranty.

VERDICT

★★★⯪☆

Great 1440p gaming performance but the price will need to drop before it will offer compelling bang for buck.

Lindsay Handmer

PRICE $449 **WEB** www.dell.com

Dell 27 Plus 4K Monitor S2725QS

A basic workhorse office monitor – and that's about all.

Many 4K monitors pitch towards either the gaming or videography/photography crowd, but if you stay away from OLED there's an ever-increasing range of more affordable 4K monitors designed for everyday use. That's precisely the niche that Dell's 27 Plus 4K S2725QS wants to fill, with specification set that lines up with its asking price.

Out of the box setup isn't a particularly challenging affair outside deciding whether you want all of the back panels installed. The S2725QS includes panel covers that obscure its secondary HDMI port if not needed. It does take the old school approach of requiring simple twist screws to attach the base stand to the back of the display. For some that'll be a charmingly retro step, though you may find (as I did) that it's just a touch fiddly thanks to the angle the screws sit at. A tiny quantity of perseverance will see you right if you're using the supplied base, though it's also VESA compatible if you're using your own monitor arm or wall mount.

At this price you don't get a wide choice of connections, with dual HDMI ports and a single DisplayPort 1.4 connection in play. The DisplayPort connection and primary HDMI port extrude from the base of the display, while the secondary HDMI port sits higher on the monitor's back. The flat white rectangular base is nondescript, but entirely suitable for stowing away a keyboard or other peripherals.

Powering up the S2725QS involves plugging in the supplied C13 type cable and your choice of HDMI or DisplayPort, with a 1.8m HDMI cable included in the box.

What you don't get here are any USB ports to connect up peripherals, or even a headphone jack, though on the audio side it is equipped with 5W stereo speakers. Temper your expectations though, because these are seriously below average units. That's fine if you simply want system beeps in a timely fashion, but as I found out, a quick way to create a headache if you try to use the speakers for gaming or watching streaming media for any length of time.

The S2725QS has a generous quantity of tilt and swivel to allow it to sit at the best height and angle for your eyes, something that's important given that it did present a degree of light bleed present from the sides that becomes more obvious at some angles. Monitor adjustments are handled with a simple joystick control at the rear, or optionally via Dell's Peripherals & Display Manager Software for Windows PCs.

You shouldn't have any expectations that a 4K 120Hz IPS LCD panel will blow you away with slick visuals, because while 120Hz can make scrolling a web page smoother, it's well below what you'd want for any kind of heavier duty gaming purpose, especially with a stated response time of 4ms. Acceptable perhaps if *Civilization VII* is your passion, but well below what you'd want in *Counter-Strike* for serious competitive play.

That's not entirely what the S2725QS is best for, however. As an everyday office work-centric monitor that might see some light entertainment use, the S2725QS is perfectly suitable, but not particularly exciting. ■

VERDICT

★★★☆☆

You're getting what you pay for with the S2725QS – including the limitations of a slower IPS LCD display.

Alex Kidman

SPECS 27-inch, matte, 3,840 x 2,160, HDR, 120Hz, IPS, 4ms response time, 350-nit brightness, 1,500:1 contrast; 2 HDMI ports (HDCP 1.4 & 2.3), 1x DisplayPort 1.4 out; Tilt, Swivel and Height adjustment: -5° to 21° tilt, -30° to 30° swivel; 13cm height, 611.44 x 518.68 x 67.40mm, 4.56KG (display)/6.47kg (display+stand).

Odyssey OLED G8
apc
HIGHLY RECOMMENDED

PRICE $1,799 **WEB** www.samsung.com/au

Samsung Odyssey OLED G8 G81SF

Samsung ramps up the 4K OLED arms race with its new G8 screens.

Samsung's new Odyssey OLED G8 is a welcome addition to its lineup, pairing a 240Hz refresh rate with a 0.03ms response time on a 27-inch 4K panel. A 32-inch option is also available, but the smaller 27-inch model that I reviewed has a greater number of pixels per inch.

Previously Samsung offered a 27-inch OLED monitor in the Odyssey G6, but it only outputs a 2K resolution albeit with a higher refresh rate. That monitor can be found today for about $1,000, but the OLED G8 has a greater $1,799 price point – sharp compared to the price of the similar Asus ROG Swift OLED PG27UCDM and on par with the MSI MPG 272URX.

Samsung's OLED panel tech is hard to beat, offering gorgeous contrasting and colour with intense darkness. The trade-off is that the screen is noticeably not very bright, capping out at 250nits, though this is a tradeoff inherent to all OLED monitors and it's rare to see brightness above this. Additionally, the panel uses pixel shifting technology to combat risks of burn-in, which explains the large bezels on the sides.

The monitor aced games like *Assassin's Creed Shadows* and R.E.P.O where darkness matters a lot, but also when watching shows like Andor where you'll want the best picture quality. It's also up to the task as a productivity monitor, without any blurring around letters and almost no reflection on the panel itself to speak of. The inbuilt operating system is fast and simple, letting you tweak your picture quality without an overwhelming slew of features.

The port layout was my favourite thing about the Odyssey OLED G8, but it's not without its problems. Each port is lined up across the back of the monitor, poking outward from the panel itself rather than downward like with most displays. This makes it simple to pull cables in and out, though I can imagine it causing issues with some third party mounts.

There's also not a lot of port variety. All the typical ports are here, including two HDMI connections and a DisplayPort, but there's only two USB-A ports for your peripherals, along with the USB-B port that connects to your computer.

A USB-C port would have been welcome, as would have more accessible USB ports across the bottom of the monitor near the front for easy access. Additionally, the back of the monitor feels quite flimsy, and I had some trouble inserting and removing cables as the plastic kept bending.

The included monitor footing is flat and doesn't take up much room, and I like the silver colourway Samsung has chosen for this monitor. The RGB ring on the back is a nice detail but I could have happily gone without it. The stand is easy to snap behind the display and screw onto the footing.

All in all, Samsung's created a worthwhile gaming screen here. I'm personally more inclined to purchase the 32-inch model, though I would have liked in-built speakers. ■

SPECS 34-inch, matte, 3,440 x 1,440, VESA DisplayHDR TrueBlack 400, 240Hz, OLED. 0.03ms response time. 250-nit brightness. 1,000,000:1 contrast. 2x HDMI 2.1, 1x DisplayPort 1.4, 2x USB-A 3.2 Gen 1 downstream, 1x USB-B upstream. Tilt, Swivel and Height adjustment: Yes. 611.7 x 554.2 x 263.5 mm, 6.9KG.

VERDICT

★★★★☆

A worthwhile contender in the 4K OLED space.

Zachariah Kelly

apc HIGHLY RECOMMENDED

PRICE $699 (256GB with stylus) **WEB** lenovo.com

Lenovo Idea Tab Pro

A brilliant all-rounder that generally betters the iPad.

Lenovo's latest tablet costs roughly as much as a basic iPad but it offers a bigger screen and even includes a stylus at no extra cost. The design isn't the most thrilling, borrowing its overall look from Lenovo's 2023 Tab P12, but the smooth metal casing is pleasant to the touch and gives an impression of durability. At 620g it's a little on the weighty side, but that's down to the large 12.7in display. While the 8mm bezels might appear slightly chunky, they help you easily hold the tablet by its edges without accidentally triggering the touchscreen.

Another nice design touch is the strong magnetic patch at the back of the Idea Tab Pro, to which the stylus attaches with a secure snap. The stylus doesn't charge when it's attached in this way – it tops up via a standard USB cable – but it has great battery life with more than 150 hours of standby time, so recharging isn't too tedious. Although the stylus itself doesn't claim to be quite as accurate as the latest Apple Pencil, I found it worked brilliantly, with impressive precision and pressure sensitivity.

Most unusually, the Idea Tab Pro also has a microSD card slot – ideal for expanding your storage or transferring files from a laptop – along with three accessory connector pins at the bottom, for connecting the optional Lenovo keyboard.

The Idea Tab Pro's big screen uses IPS technology, so it's not quite as vibrant as OLED rivals, but it's still got punchy colours and a smooth 144Hz refresh rate. This is a big win over the 60Hz screens found on other tablets, including the iPad and iPad Air – the extra smoothness is instantly noticeable when scrolling websites or social media feeds. Viewing angles are also surprisingly good, making it easy to use the tablet either propped up on a stand or flat on a table.

Unexpectedly, audio is another strength. The four JBL-tuned speakers go impressively loud without losing detail and offer a great sound profile that's punchy without being too heavy on the bass. Throw in Dolby Atmos support and you have a sound system that can really do justice to intense action movies, catchy TV show theme tunes or long video podcasts.

The processor inside this tablet is a MediaTek Dimensity 8300 processor and 8GB of RAM. That's a mid-range specification, but I tried multitasking with a range of apps and saw no noticeable slowdown. The Idea Tab Pro's large 10,200mAh battery gets you easily through an entire day of use and then some.

While it might not quite match up to Apple's silicon for sheer performance, the Idea Tab Pro is a strong rival for general productivity or gaming, offering a bigger screen, a smoother refresh rate and awesome speakers. Let's not forget Lenovo's custom OS features either, which aren't matched by the iPad – or other Android tablets.

Before buying it is worth remembering that many leading tablet apps are still exclusive to Apple's ecosystem, including stylus-driven art tools such as Procreate. The Lenovo's heavier weight and larger size also make it less convenient than a standard iPad as a take-anywhere sketch pad. In all though it's a great all-round tablet at an excellent price. ■

SPECS 8-core 3.35GHz/3.2GHz/2.2GHz MediaTek Dimensity 8300 SoC; Mali G615-MC6 graphics; 8GB RAM; 12.7in 144Hz IPS touchscreen, 2,944 x 1,840 resolution; 128GB/256GB storage; 13MP rear camera; 8MP front camera; Wi-Fi 6E; Bluetooth 5.3; USB-C 3.2 Gen 1; 10,200mAh battery; Android 14 (two OS updates); Lenovo Tab Pen Plus; folio keyboard; 292 x 6.9 x 189mm (WDH); 620g; 1yr C&R warranty.

VERDICT

★★★★☆

A genuine rival to the iPad due to its 12.7in 3K screen and bundled stylus, even if the OS can't match Apple's.

Dashiell Wood

apc
HIGHLY RECOMMENDED

PRICE $447 **WEB** rayneo.com

RayNeo Air 3s

If you're in the market for AR glasses, and don't want to splash out on pricier options, these are a bargain.

Established in 2021, RayNeo has made its niche producing simple, affordable smart glasses. It doesn't try to match the rich feature sets of arch competitor Xreal, instead focusing on price - something the Air 3s, its latest model, sticks to whilst offering improved performance and vastly superior audio over prior generations.

To be clear, this isn't a self-contained VR headset like the Meta Quest 3. It's a virtual display that plugs into a host device and simulates a huge 201in screen floating six metres in front of your face. It will work with almost any device that supports video over USB – which means you can use most smartphones, tablets, PCs and Macs.

Design-wise, the front of the Air 3s is a shaded, single-piece lens, with silver-coloured, three-position arms at the sides; the left one houses a volume rocker and a menu button, while the right arm has a brightness rocker and a USB-C port at the end for connecting to your host device. The supplied cable has a slight downward bend, which prevents it from sticking straight out behind you.

On the inside of the lens, the Air 3s uses Sony micro-LED panels, as do most consumer AR glasses. These offer a crisp 1080p resolution with a smooth 120Hz refresh rate, and RayNeo's own HueView screen technology to deliver a rich palette of colours. As a result, the Air 3s comply with the IMAX Enhanced standard, covering 98% of the cinematic DCI-P3 space. They also boast a maximum brightness of 650cd/m2 and a native contrast ratio of 200,000:1 – twice as bold as the Air 2s.

Alongside the glasses, RayNeo supplies two nose pads (one of which is already installed), a sample frame for prescription lenses, a cleaning cloth and a hard carrying case. This is thoughtfully designed, with enough room for the glasses, the USB cable and the cleaning cloth.

While the Air 3s have the same resolution and refresh rate as the Air 2s, the image quality is markedly better. With the older model, details became blurry towards the periphery of my field of vision, but I had no such issues with the Air 3s, even when spending multiple hours using the glasses to write and edit articles. And I'm delighted to report that RayNeo has also upgraded the audio system, which was a particular weakness of the Air 2s. A new four-speaker setup offers a claimed 200% boost in acoustic performance, and the nasty distortion I noticed with the previous glasses is completely gone.

This creates an experience that's ideal for entertainment, and I thoroughly enjoyed gaming on the Air 3s. For example, *Microsoft Flight Simulator 2024* and *Forza Horizon 5*, running off a Lenovo Legion Go S handheld PC, were incredibly immersive; playing a night-time scenario in these simulators, with your own ambient lights turned off, is a transformative experience.

I also enjoyed spending five and a half hours watching *Inception* and *Oppenheimer* with the glasses – an experience greatly enhanced by the upgraded audio system. I would have liked more bass, but there's little else to complain about in terms of audio performance.

In all, the RayNeo Air 3s are a big step up from their predecessors. The audio upgrade is particularly significant – the difference is like night and day – but the sharper, more consistent image also helps banish any sense of compromise. ■

VERDICT

★★★★☆

These well-priced AR glasses produce a gorgeous picture and clear audio, making them a great choice for long journeys.

Brandon Hill

SPECS 2 x120Hz micro-OLED displays; 1,920 x 1,080 resolution per eye; 47° field of view; 3 DoF; 650cd/m2 peak brightness; 4 x microspeakers; 170 x 147 x 48mm (WDH); 76g; 1yr warranty.

PRICE $249 **WEB** au.creative.com

Creative Sound Blaster G8

A versatile and affordable desktop DAC for gamers and audio buffs.

GAME
VOICE
VOL –
+ VOL
Sound BLASTER
SBX
MODE
HP/SPK

apc
EDITOR'S CHOICE

Creative's Sound Blaster G8 is primarily aimed at gamers, but its most impressive feature – the ability to combine and mix two separate audio sources - will appeal to lots of other people too.

The compact and sturdy design of the G8, and the fact that it can draw power from a USB-C port on a notebook, means that you could easily slip it into a backpack or bag and carry it with you if you needed to. However, its impressive range of connectivity features mean that it will probably work best on your desktop as part of a wider audio system. The back panel houses two USB-C ports, which can support high-res audio up to 32-bit/384KHz, so the G8 can handle the best audio quality available on streaming services. The first USB-C port can be used both for charging and audio input, while the second is for audio input only, and there are two USB-C cables included as well.

The USB-C ports provide compatibility with most computers and mobile devices, but there are also two optical connectors for input and output that will work with more traditional hi-fi equipment, and an HDMI port for use with a TV or games console. The front panel also provides two 3.5mm jacks for headphones as well as a microphone, with two more for Line In and Line Out ports on the back.

The real standout feature, though, is that the G8 has two separate volume controls, which enable you to combine two audio inputs and then output them on a single device, such as your headphones or speakers, or streaming the audio online. The larger dial on the top panel is the master volume control, while the smaller dial enables you to adjust the balance between the two audio inputs. This feature is very much aimed at gamers and streamers, who want to combine the audio from games with their own voice commentary or team-chat while streaming.

> "The real standout feature, though, is that the G8 has two separate volume controls, which enable you to combine two audio inputs and then output them on a single device, such as your headphones or speakers, or streaming the audio online."

The Creative App includes a number of additional features, such as a 10-band equaliser that lets you fine-tune the sound, support for Dolby Digital surround sound, and Creative's own Acoustic Engine, which provides additional controls, such as boosting the bass or enhancing voices and dialogue in video and games.

That's an impressive range of features, especially as the G8 is very competitively priced at just $249. However, none of those features would matter if the audio quality wasn't up to scratch. The G8 doesn't disappoint, though, and works a treat with the 24-bit high-res version of Sturgill Simpson's Sing Along. This track is a wonderful mash-up of rock guitar and EDM keyboards, but the G8 knows how to balance all the different sounds and keep each instrument clear and distinct. The electronic keyboards fizz through the air with an infectious dance-floor energy, but the sound is grounded by the heavy, grinding guitars that form the bedrock of the track. The G8 is able to pick out lighter details, such as the precise ticking of percussion that holds the piece together, but it also lands the bass drop towards the end with real weight.

There are certainly less expensive DACs available for people who just want to improve the sound quality on their PC, Mac or mobile devices, but the G8's impressive connectivity features and its ability to combine and mix audio sources will ensure that it earns its keep. ■

SPECS 2x USB-C, 2x optical, 4x 3.5mm, 1x HDMI; Cirrus Logic CS43198 DAC; supports 32-bit/384KHz audio; 52x125x91mm.

VERDICT

★★★★★

The ability to combine and mix two separate audio sources helps the G8 stand out in a crowded market.

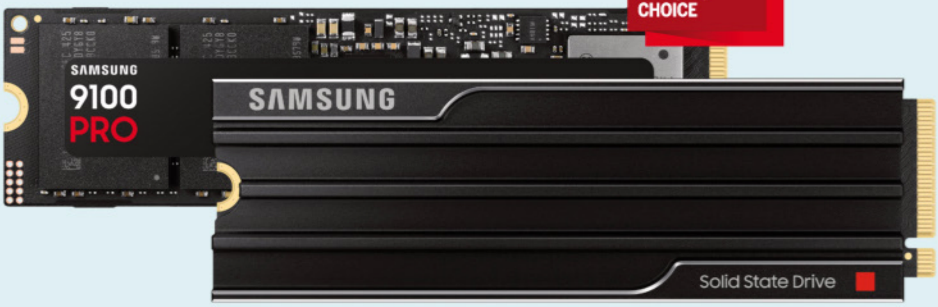
Cliff Joseph

PRICE $299 (1TB), $459 (2TB), $839 (4TB) **WEB** samsung.com

Samsung 9100 Pro SSD

Samsung's first true PCIe 5.0 drive is the best there is.

apc
EDITOR'S CHOICE



Starting at $299.99 for a 1TB capacity drive, the 9100 Pro is Samsung's first 'true' PCIe 5.0 SSD after the Samsung 990 EVO and Samsung 990 EVO Plus. Both those drives are PCIe 5.0, but they only use two PCIe 5.0 lanes, which limits their practical speeds to PCIe 4.0 standards.

The 9100 Pro, meanwhile, is a full-fat PCIe 5.0 x4 M.2 drive, meaning its theoretical max speed for sequential reads is upwards of roughly 15,000MB/s and 14,000MB/s for sequential writes.

Samsung promises that its latest drive can hit up to 14,800MB/s sequential read and 13,400MB/s sequential write, and the Samsung 9100 Pro gets there. The T705 hits a max sequential read speed of 14,390MB/s in CrystalDiskMark 8 on the same testbench with a Gigabyte Aorus X870E motherboard, AMD Ryzen 9 9950X processor, and 32GB Corsair Dominator DDR5 running at 6,600MT/s and integrated graphics, so there's no interference from a graphics card.

Meanwhile, compared to its predecessor, the Samsung 990 Pro, the 9100 Pro is a much better overall drive, but there are circumstances where the 990 Pro still manages to outperform its successor such as same and secondary drive copy time and random read and write speeds.

On balance, the Samsung 9100 Pro isn't the undisputed best SSD you can buy, and for some users (such as gamers or general-use enthusiasts), you will likely be happier with other PCIe 5.0 or even PCIe 4.0 drives on the market, many of which will be cheaper than the 9100 Pro.

That said, this is a drive for professional users and for those who need to save or otherwise write large files to disk regularly, and for that, the Samsung 9100 Pro is the best M.2 SSD on the market.

The 9100 Pro unit we tested did not come with a built-in heatsink (though a model with a heat sink is available), so its thermal performance is largely a factor of the excellent PCIe 5.0 heatsink on the Gigabyte Auros X870E motherboard we used for testing (we also used the AMD Ryzen 9 9950X and 32GB of Corsair Dominator DDR5 RAM at 6,600MT/s), so we can't speak much to the heatsink's quality in this review.

Also, we tested a 9100 Pro with a 4TB capacity, whereas every other drive we tested had a 2TB capacity. This, in itself, shouldn't impact baseline scores too much, if at all, but it's worth pointing out that while we still consider this an apples-to-apples comparison, it's more of a Cosmic Crisp-to-Red Delicious comparison, so your actual experienced performance might vary slightly from mine.

All that said, the only problem with this drive is its price. It's an expensive drive, and for a lot of gamers and those who are more interested in faster loading times for their programs and files, the Crucial T705 is simply a better option with comparable write speeds but close-to-max read speeds for a lower price.

If you're looking for a drive that you can use in more of a professional capacity with frequent saves of very large files like video projects or video game packages in Unreal Engine, the Samsung 9100 Pro is the best SSD you're going to get for that purpose and it will absolutely speed up your everyday workflow considerably.

Gamers won't find much here worth the investment, unfortunately, with even the 990 Pro outperforming the 9100 Pro in 3DMark's SSD benchmark, which is a gaming-exclusive test. ■

> "If you're looking for a drive that you can use in more of a professional capacity with frequent saves of very large files like video projects or video game packages in Unreal Engine, the Samsung 9100 Pro is the best SSD you're going to get for that purpose."

BENCHMARK RESULTS	Samsung 9100 Pro 4TB	WD Black SN7100 2TB	Corsair MP700 Elite 2TB	Samsung 990 Pro 2TB
Crystal Disk Mark				
Random read (IOPS)	25,745	31,836	26,055	25,133
Random write latency	11.45	11.25	9.35	13.32
Peak sequential read (MB/s, 1MB QD8)	14,287	7,137	10,421	7,153
Peak sequential write (MB/s, 1MB QD8)	13,175	6,860	8,814	6,820

VERDICT

★★★★⯪

The Samsung 9100 Pro is Samsung's first 'true' PCIe 5.0 SSD, and it definitely delivers fantastic performance with the fastest write speeds we've ever tested.

Ben Mansill & John Loeffler

PRICE $847 (128GB) **WEB** store.google.com

Google Pixel 9a

Is this 'budget' phone also the best phone overall for the year so far?

For a long time, Google has been nearly untouchable when it comes to mid-price phones, but recent newcomers such as the $849 Nothing Phone 3a Pro and Apple's $999 iPhone 16e have put it under pressure. The Pixel 9a reclaims the crown thanks to strong hardware, powerful AI features – and very competitive pricing.

The Pixel comes in four chic colours – Iris, Obsidian, Peony and Porcelain – although it lacks something of the character of previous models. That's because Google has replaced the distinctive camera bar with a smaller, more conventional bump. You may appreciate the simpler look, but to me it feels like a shame to lose such a key part of the Pixel's identity.

Other changes are subjective too, such as the flat sides and rounded corners; if it weren't for the dual cameras on the back, the Pixel 9a would look an awful lot like the iPhone 16e.

On the plus side, it isn't as sharp around the edges, so it's nicer to hold in the hand, and its aluminium frame and composite matte casing feel solid. One more big positive: an IP68 rating for water and dust resistance.

Display and cameras

The Pixel 9a's 6.3in OLED screen looks gorgeous, with an adaptive 120Hz refresh rate that makes animations slick and fluid in a way the iPhone 16e's 60Hz display can't match. Even more impressive is how bright it gets, with a stunning peak brightness of 2,076cd/m2: no other mid-range phone comes close, with the iPhone 16e delivering little more than half as many lumens. Colour coverage is terrific, too, with 94% of the DCI-P3 gamut in play.

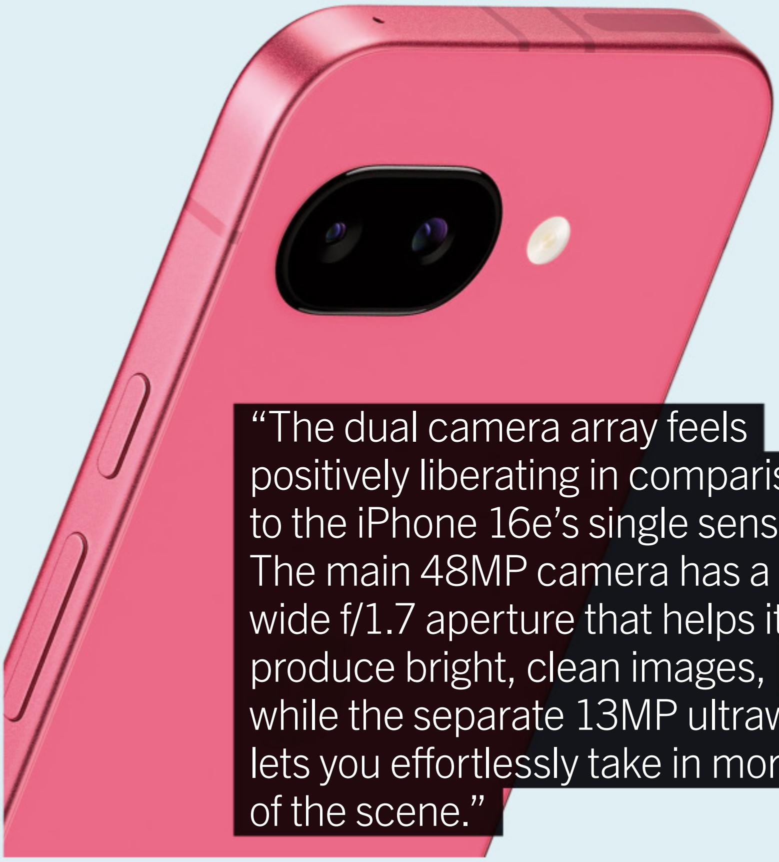
On the other side of the phone, the dual camera array feels positively liberating in

SPECS 8-core Google Tensor G4 processor; 8GB RAM; Mali-G715 MP7 graphics; 6.3in 120Hz P-OLED screen, 1,080 x 2,424 resolution; 5G; 128GB/256GB storage; IP68 rating; dual 48MP/13MP rear cameras; 13MP front camera; Wi-Fi 6E; Bluetooth 5.3; NFC; 5,100mAh battery; USB-C 3.2 Gen 1; Android 15 (7 major updates); 73 x 8.9 x 155mm (WDH); 186g; 1yr warranty.

comparison to the iPhone 16e's single sensor. The main 48MP camera has a wide f/1.7 aperture that helps it produce bright, clean images, while the separate 13MP ultrawide lets you effortlessly take in more of the scene. Shots taken on the main camera compare favourably to those on the iPhone 16e. Detail levels are similar – which is to say, very good – but my test shots from the Pixel looked more natural in tone, while the iPhone tended to oversaturate reds and oranges.

The 9a also gains a new macro focus mode, which leans on AI to enhance and process closeups, and I'm excited to finally see Night Sight coming to an A-series phone. The iPhone 16e does very well at picking out detail in almost pitch-dark conditions, but the Pixel 9a brightens up more of the shadows, resulting in a better-balanced overall picture.

In terms of AI assistance, the Pixel 9a benefits from most the same tools as Google's high-end phones, including Add Me, Audio Magic Eraser, Magic Editor and Best Take. And on the video side the Pixel 9a should meet almost anyone's needs, with 4K recording at up to 60fps and a slow-motion mode that shoots 1080p footage at 240fps.



> "The dual camera array feels positively liberating in comparison to the iPhone 16e's single sensor. The main 48MP camera has a wide f/1.7 aperture that helps it produce bright, clean images, while the separate 13MP ultrawide lets you effortlessly take in more of the scene."

Performance

The Pixel 9a uses the same Tensor G4 processor as the Pixel 9 and 9 Pro, so it's effectively a premium-performance handset. Although it has only half as much RAM as my Pixel 9 Pro XL, I couldn't feel any difference between the two handsets in everyday tasks.

Benchmark tests confirm that the 9a performs very similarly to the Pixel 9, with Geekbench 6 scores of 1,707 and 4,512 in the single-core and multicore tests respectively. However, as is usual with Google's Tensor chips, number-crunching power is nowhere near a match for Apple, with the iPhone 16e scoring 3,328 and 8,132 in the same tests. Likewise, the Pixel 9a can't keep up with the iPhone 16e's graphical performance, achieving an average frame rate of 57fps in the 3DMark Wild Life Original Unlimited test, versus 71fps for the iPhone 16e. Unless you're a die-hard gamer, though, I wouldn't worry: I couldn't spot any significant difference in graphically intensive games such as *Modern Combat* and *Age of Origins*. If anything, they look smoother on the Pixel 9a thanks to the screen's higher refresh rate.

AI functions

The Pixel 9a's AI features extend well beyond the camera, incorporating most of the capabilities of Google's premium phones – which are considerably more advanced and practical than the Apple Intelligence features you get with the iPhone 16e. For example, Apple has nothing close to Google's Call Screen feature, which takes calls for me when I'm busy, and even offers me contextual responses I can choose while "screening" the call.

I also love the way that the Gemini Live interactive assistant now works with the camera. I tried pointing it at a hallway in my home and asking what kind of artwork I should hang; to my amazement, not only did Gemini Live give me aesthetic advice, it analysed the setting, detected that most of the lighting comes from a window in an adjacent room and recommended installing track lights to better display the artwork. The Pixel 9's AI capabilities are already one its greatest selling points – and you can expect them to get better and smarter over time thanks to a full seven years of software support.

Battery life and charging

The Pixel 9a comes with a 5,100mAh battery that got me through a full working day without worries. In our battery benchmark test it lasted an average of 13hrs 8mins on a full charge – well up from the old Pixel 8a's time of 11hrs 21mins in the same test. It also beats the iPhone 16e, which got to 12hrs and 41mins, although the budget longevity champion remains the Nothing Phone 3a Pro on 14hrs 33mins.

Wired recharging is supported at a maximum of 23W, and with a high-power supply I found 15 minutes of charging got the battery from empty to 25%, reaching 47% after half an hour. Wireless charging however remains stuck at a leisurely 7.5W, so it will take a good few hours to fully recharge on a pad.

So, should you buy the Google Pixel 9a? If you're focused on cost, take a look at the $599 Nothing Phone 3a alongside its Pro brother: both give you a lot for lower prices. However, the AI features alone of the Pixel 9a give it a huge advantage over its rivals, particularly the more expensive iPhone 16e.

Taking value for money into account – alongside factors such as performance, screen quality, features and support – the Pixel 9a isn't simply the best mid-range phone around, but arguably the best all-round smartphone of 2025. ■

VERDICT

★★★★★

Quite simply the best mid-range phone around, with useful AI features, long battery life and excellent cameras.

John Velasco

NEEDS Windows 10 or 11, macOS or Linux **WEB** 4kdownload.com/products/videodownloader-42

4K Video Downloader Plus 25

Video downloader

Downloading videos from streaming services typically means either paying for a subscription or using a third-party tool, many of which are stuffed with ads and trackers. 4K Video Downloader Plus isn't perfect – it's freemium, so some features are restricted to its paid-for plans – but it's the easiest way to save videos to your desktop to watch offline.

It's a significant upgrade over its predecessor, 4K Video Downloader (without the 'plus'), which was discontinued on 1 February. A built-in browser lets you search for videos and music on popular services including YouTube, Dailymotion, SoundCloud, Facebook and TikTok, and download them with one click. Alternatively, paste a video or audio link from your standard browser to download it instantly. You can also save YouTube playlists and channels.

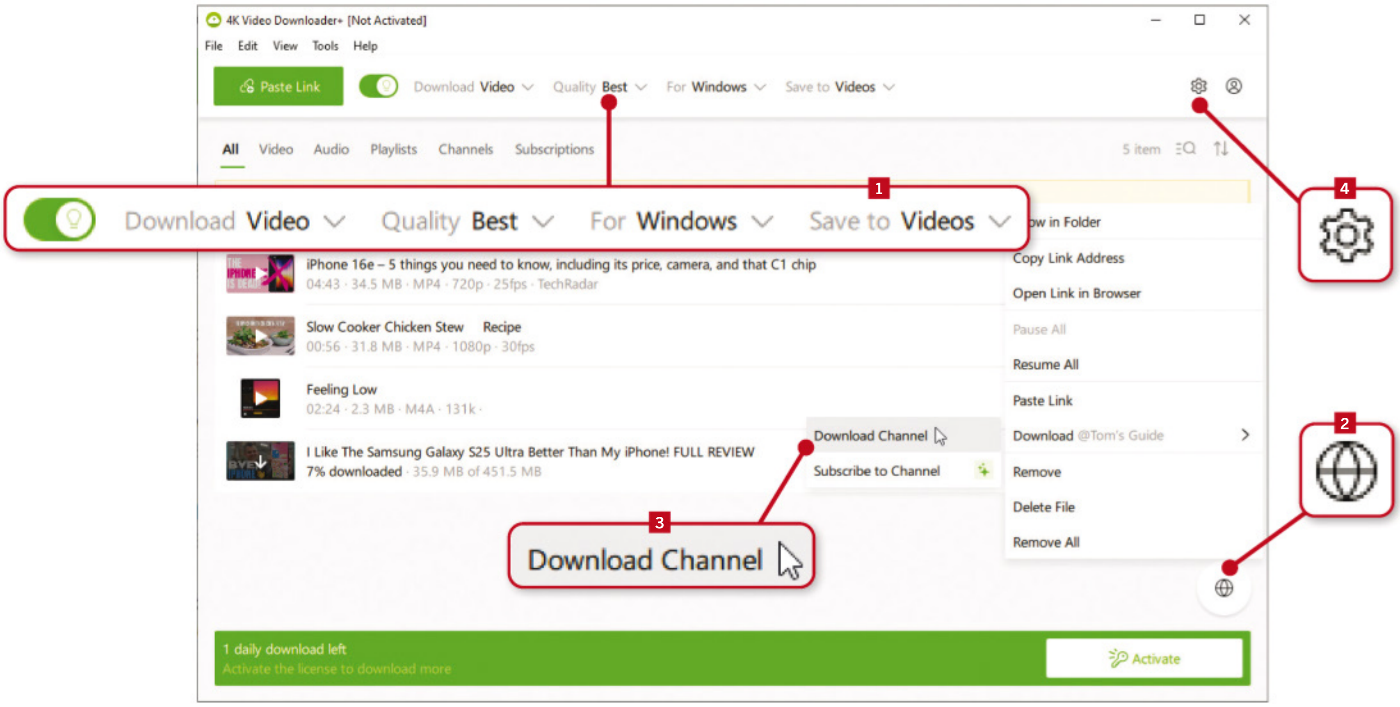
The program's handy Smart Mode saves you having to configure download settings every time you download a video. Specify your preferred quality (resolution and frame rate), format and download folder, and it will apply your preferences to every video you download.

4K Video Downloader Plus 25 (the '25' indicates the year not the version number) makes it easier to download every video from a YouTube channel. Click the three-dot icon next to a download and choose Download then Download Channel.

It also displays larger thumbnail images of videos when browsing channels and playlists – click the Enlarge button in the top-right corner of the download window. Note that this only works when Smart Mode is switched off.

The updated program improves the speed and reliability of downloads, reducing the number of errors, and works better with media players.

4K Video Downloader Plus limits you to downloading 10 videos a day, either individually or from a playlist, but only five from a channel, and only one at a time. For unlimited downloads (up to three simultaneously), subscribe to the Lite plan for US$15 a year or buy the Personal version for US$24.



iPhone 16e – 5 things you need to know, including its price, camera, and that C1 chip
04:43 · 34.5 MB · MP4 · 720p · 25fps · TechRadar

Slow Cooker Chicken Stew Recipe
00:56 · 31.8 MB · MP4 · 1080p · 30fps

Feeling Low
02:24 · 2.3 MB · M4A · 131k ·

I Like The Samsung Galaxy S25 Ultra Better Than My iPhone! FULL REVIEW
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1 The Smart Mode in 4K Video Downloader Plus applies your download preferences to every video and audio file you save. Use the dropdown menus to select your preferred format, quality and download folder, and the device you play content on.

2 Click the globe icon in the bottom-right to switch to the program's browser. This lets you browse and search for videos to download on services including YouTube, Dailymotion and TikTok. Sign into your account with a service to access your playlists.

3 You can now download all the videos from a YouTube channel, by clicking the three-dot icon and choosing Download then Download Channel. However, the free version of the program limits you to saving the first five videos from the channel.

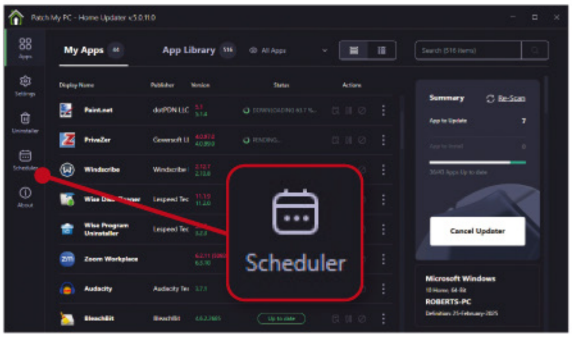
4 Click the Preferences cog to customise how 4K Video Downloader Plus works. You can adjust its download speed, have it display notifications when downloads are complete and stop the program running in the background when you close it.

SOFTWARE UPDATER

Patch My PC Home Updater 5.0.11.0

WEB patchmypc.com/product/home-updater **NEEDS** Windows 10 or 11

Patch My PC has been a decent updater for some time, though a few bugs and lack of wide support held it back a bit. Now it's received an update of its own to patch some bugs and add support for even more programs. Most notably, Patch My PC has fixed a problem that caused software to show as 'Updating' even after it had updated. It has also improved its Scheduler (see screenshot) to make it better at checking for and installing new versions of programs at your preferred time and frequency. New additions to Patch My PC's library of supported software include video editor LosslessCut, AI-powered photo-repair tool Wise ImageX and gaming service Nvidia GeForce Now. It has dropped support for download manager EagleGet and Google's discontinued 'Backup and Sync' tool.

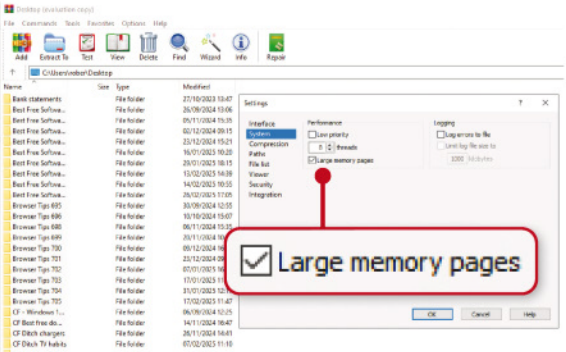


FILE COMPRESSION TOOL

WinRAR 7.10

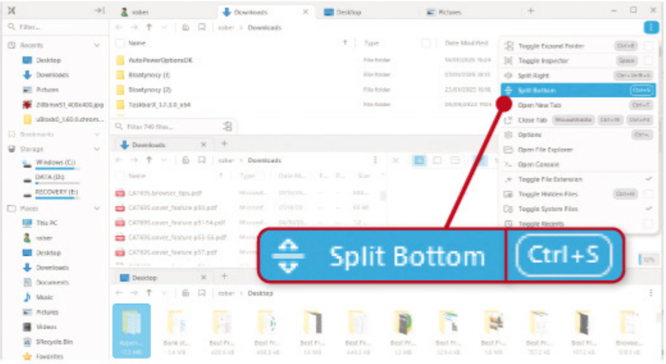
WEB win-rar.com **NEEDS** Windows 10 or 11

WinRAR has been around for 30 years and is no longer an essential compression tool – especially now that Windows 11 can open RAR archives. But the latest version proves there's life in the old program yet by making some welcome changes. WinRAR's Settings box, which you access through its Options menu, has been redesigned to display categories in an easier-to-navigate left-hand menu rather than tabs across the top. It has also split the Interface and System settings into separate sections, and added a long awaited dark mode to the former. Another new option boosts compression speed when you pack big files into RAR or ZIP archives. Select 'System' and tick the box 'Large memory pages' (see screenshot). WinRAR has now dropped its 32bit version, but retains its 40-day 'free trial', which famously never ends.



Should I pay for?

Choose the right version of software



File Pilot

WEB filepilot.tech **PRICE** $64

FREE TRIAL Free while in beta **NEEDS** Windows 7, 8.1, 10 or 11

File Pilot is a new alternative to File Explorer that promises to make finding, inspecting and managing files feel like "second nature". It's currently in beta and free to use, but will cost $80 once officially released ($64 if you buy a licence now).

Our first impression on running File Pilot is that it's incredibly lightweight and fast, launching instantly. Much as we love the file manager Files (**files.community/**), it can be slow to load. Less promising was that File Pilot froze when we right-clicked a folder, and displayed a 'fatal exception' error message.

Once the program restarted (and we'd resolved not to right-click any folders), we explored its interface and features. Like Files, it offers tabbed browsing, so you can switch easily between multiple folders and drives, and a split-screen view that displays them side by side – or horizontally (split bottom) if you prefer (see screenshot).

We particularly like the Inspector tool, which shows large previews of image files in a sidebar when you press the Spacebar. This saves you having to open a separate image viewer, and you can quickly close the sidebar by pressing Space again.

Other useful options let you show hidden and system files, switch between list, details and tile view, customise the layout's colour, font and spacing, and allow files to be opened with a single click.

OUR VERDICT: DON'T PAY FOR IT

File Pilot's speed and customisability are very impressive, but its features don't justify its high licence price, especially at the beta stage when it clearly still has bugs. Files has more options and is free to download. ■

"We particularly like the Inspector tool, which shows large previews of image files in a sidebar when you press the Spacebar. This saves you having to open a separate image viewer, and you can quickly close the sidebar by pressing Space again."

DEVELOPER The Debian Project **WEB** www.debian.org **LICENCE** DFSG-compatible licences, plus proprietary

Debian 12.10

Nate Drake explores the latest stable point release for Bookworm. Does the OS still live up to its reputation for stability?

We last covered Debian 12 (code name Bookworm) almost two years ago. As most readers know, the OS is one of the oldest versions of Linux in active development.

Debian follows a painstaking development process, whereby project members carefully curate packages for stability. This is why the OS forms the basis of so many popular Linux distros, such as Ubuntu.

Packages are initially only accepted into Debian's unstable branch. To become a candidate for the next release, it must be migrated into the testing branch. This is a meticulous process, as packages must not have any release-critical bugs, nor can they break any existing code used in the testing branch.

The Debian Project is currently on the verge of the next major release of Debian. Version 13, code-named Trixie, is scheduled for summer 2025.

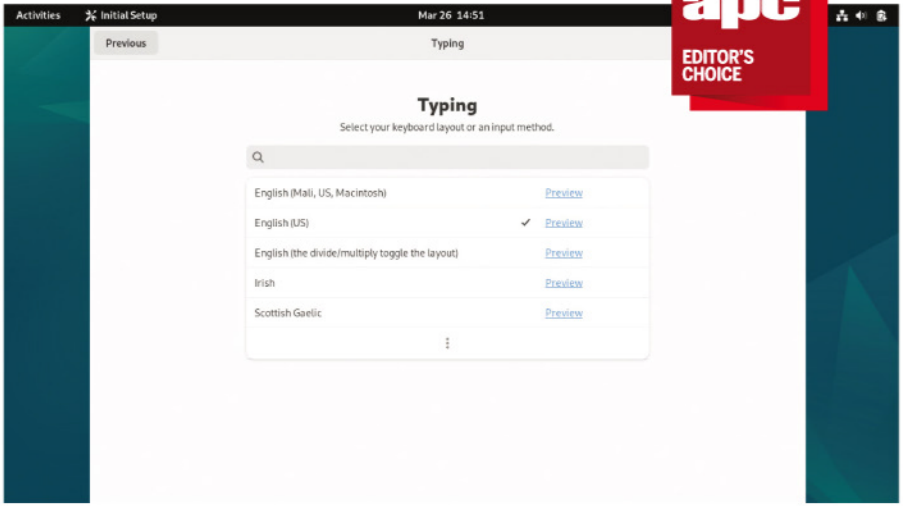
In the meantime, this tenth update of the stable version contains numerous bug fixes and security patches. There are multiple installation images, including a small 'netinst' ISO of around 630MB, which can download required packages as required.

We opted for a live image of Debian running the Gnome desktop, though other flavours are available with KDE, XFce, LXDE, and Cinnamon.

On first boot, we were greeted by the Initial Setup window, prompting us to select basic configuration options like the keyboard layout. From here, you can also disable location services and connect online accounts such as Google, Nextcloud or Microsoft.

Once the Gnome desktop loaded, we chose to launch the installer, which is based on Calamares, via the dock. After choosing our region and keyboard layout (again) we could erase the current partition. Full disk encryption is supported. Once installation was underway, setup completed in our virtual machine in less than six minutes. This puts it on a par with other major distros we've reviewed, like Arch and Ubuntu.

APC EDITOR'S CHOICE



Select your keyboard layout or an input method.

Debian's Welcome screen seems identical to the live Setup Assistant. From here you can configure options such as the keyboard layout.

> "We launched System Monitor and discovered that with no other graphical apps running, Debian used just 1.5GB of virtual RAM. CPU usage hovered around 1%."

Upon restarting our virtual machine (which automatically ejected the live install disk), we were greeted by Debian's Welcome window, which is identical to Initial Setup.

We launched System Monitor and discovered that with no other graphical apps running, Debian used just 1.5GB of virtual RAM. CPU usage hovered around 1%.

Debian has a carefully selected collection of default apps, which are chosen for stability, such as Firefox ESR (Extended Support Release). This emphasis on stability is also shown when examining app versions. For instance, the most recent version of LibreOffice is currently 25.2.1; however, Debian 12.10 uses v7.4.7.2.

You can install additional programs via the default package manager, which in our case was Gnome Software. We used this to install VLC directly from Debian repositories and were pleased to see this reflected the most recent stable release (3.0.21).

This raises an important dilemma as to whether Debian is truly suitable as a daily driver. On one hand, choosing and testing packages carefully results in a very stable system, which is why major versions of Debian are released only once every few years.

On the other hand, using older versions of software means users can't take advantage of the latest features. They can also be prone to security bugs.

This latest point release addresses this dilemma by including a number of upgrades. Certain packages that are no longer maintained have also been removed for security reasons. ■

VERDICT

★★★★½

This point release isn't as major as the upcoming Debian 13, but does address numerous bugs and security issues.

Nate Drake

DEVELOPER SGS, Shrinivas Vishnu Kumbhar et al **WEB** https://garudalinux.org **LICENCE** Mainly GPL-3.0

Garuda Linux 250308

Nate Drake dives into this Arch-based distro, named after a divine bird. Is it a soaring eagle or just a lame duck?

This Arch-based distro follows a rolling-release model. However, the development team has released snapshots of Garuda annually since 2012. The latest version, code-named Broadwing, is available in a variety of spins.

These include versions with Garuda's dr460nized desktop, a custom version of KDE Plasma designed to resemble Mac OS. Alternate spins include versions with COSMIC, Gnome, Cinnamon, XFce and Mokka – a Catppuccin pastel-themed KDE desktop, which is the focus of this review.

After downloading the weighty 3.1GB ISO, we booted into Garuda's live environment from a virtual machine. We noted, however, that the main site's download page advises against doing this due to missing graphics acceleration.

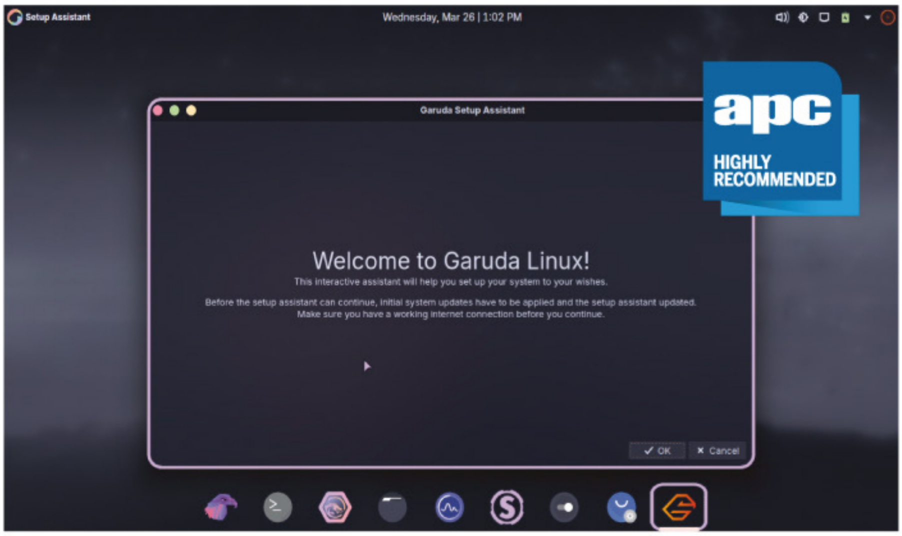
Setup is handled by the Calamares installer. After choosing the account, we opted for a clean install. System encryption is supported.

Once setup was underway, it completed in around three minutes. However, upon restarting our VM, Garuda's setup assistant launched. This prompted us to update the OS by downloading 287 files totalling 935MB via Konsole, including a firmware update.

Once the updates were complete, the setup assistant listed options to install drivers for printer/scanner support and extra wallpapers. There's also an option to load the BlackArch repo to install pen-testing skills. As we didn't care for Garuda's dark theme, we opted to install the wallpapers, which once again were downloaded via Konsole.

Once completed, we were pleased to see that the setup assistant offered links to the Garuda Linux forum and wiki. One restart later, we were greeted by Garuda Rani. This is a new Garuda-specific application, which the release notes describe as the "future of Garuda utilities". In plain English, Rani seems to be a one-stop application for customising and managing the system.

> "Wwith no other apps running, Garuda consumed only 1.8GB of virtual RAM, though it used around 10% of resources for our four virtual CPUs. The install footprint was also quite light at just over 9.1GB."



Welcome to Garuda Linux!

This interactive assistant will help you set up your system to your wishes.

Before the setup assistant can continue, initial system updates have to be applied and the setup assistant updated. Make sure you have a working internet connection before you continue.

While the setup assistant no doubt makes life easier, it required us to download hefty updates immediately after installation.

We took this opportunity to launch Whoogle, a self-hosted proxy that can provide greater privacy when searching Google. Choosing this automatically loaded the default FireDragon browser (a fork of Floorp), which displayed the Garuda's site's implementation of Whoogle. The site also seemingly hosts its own deployment of the BitWarden password manager, which you access by choosing VaultWarden in Rani.

Next, we launched System Monitor. The Garuda downloads had previously warned that the listed requirements were so heavy due to Calamares requiring so much RAM during install. It also mentioned that system RAM usage may seem to be high due to Garuda deploying zram.

Nevertheless, with no other apps running, Garuda consumed only 1.8GB of virtual RAM, though it used around 10% of resources for our four virtual CPUs. The install footprint was also quite light at just over 9.1GB.

For such a large ISO, we were surprised to see that Garuda doesn't contain many default apps. There's no mail client or office suite, though we noted that the OS does include FireDragon, Okular and VLC.

Software is handled by the handy Pacman front-end Octopi, so we fired it up and installed the Thunderbird mail client without any issues. The program appeared in the Internet category in the app menu, and its icon appeared in the dock when we launched Thunderbird.

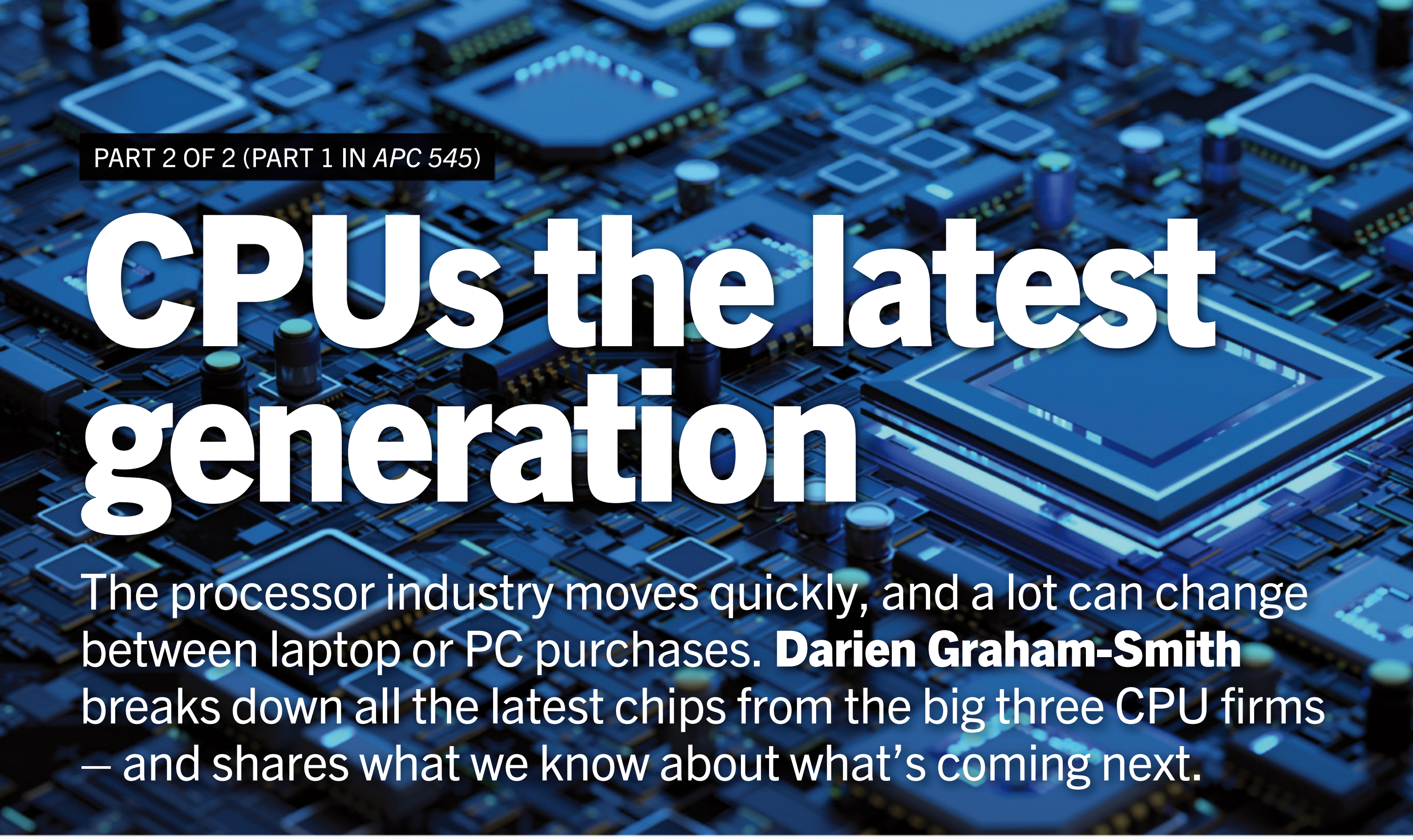
Apart from being an obvious tribute to Mac OS, the dock deserves special mention as from here you can access system settings. As we previously said, the brooding theme wasn't to our taste, but you can switch to the lighter Breeze if you wish. ■

VERDICT

★★★★☆

Garuda takes a while to set up and update but the Rani app promises to make system customisation much easier.

Nate Drake



PART 2 OF 2 (PART 1 IN *APC 545*)

CPUs the latest generation

The processor industry moves quickly, and a lot can change between laptop or PC purchases. **Darien Graham-Smith** breaks down all the latest chips from the big three CPU firms – and shares what we know about what's coming next.

AMD

AMD's Ryzen processors have always been popular with cost-conscious shoppers seeking performance on a budget. One reason for this is that AMD generally manages to cram more cores into its chips than competing Intel models. AMD long ago outsourced its chip production to Taiwan-based specialist TSMC, so it's been able to take advantage of industry-leading manufacturing processes; as a result, very complex chips with a dozen cores or more can be reliably manufactured with smaller and smaller process sizes. Meanwhile, as we noted last month, Intel has struggled to shrink its own in-house manufacturing processes, meaning it's been playing catch-up almost since the very first AMD Ryzen processor was released in 2017.

The latest AMD processors are based on the fifth major generation of its Zen core, officially dubbed "Zen 5", and internally codenamed "Nirvana" by AMD. This replaces the Zen 4 "Durango" core, introduced in 2022.

Chips based on the Zen 5 core are known either as the Ryzen 9000 series or as Ryzen AI for models that include a dedicated NPU. The core logic is the same across the whole range, which currently comprises eight desktop chips and 13 mobile processors – not to mention 27 server-oriented Zen 5 chips sold under AMD's Epyc brand.

The consumer chips covers a wide spread of capabilities (see p44). As well as differing core counts and clock frequencies, different models include different GPU and NPU hardware and varying quantities of cache. The X3D" models have an extra-large 128MB L3 cache to boost performance in games and other demanding applications – it's called 3D cache because it's physically stacked on top of the regular cache. Many models are also available in "Pro" variants, which (similarly to Intel's vPro technology) include business-oriented management and platform-security features, but are otherwise identical.

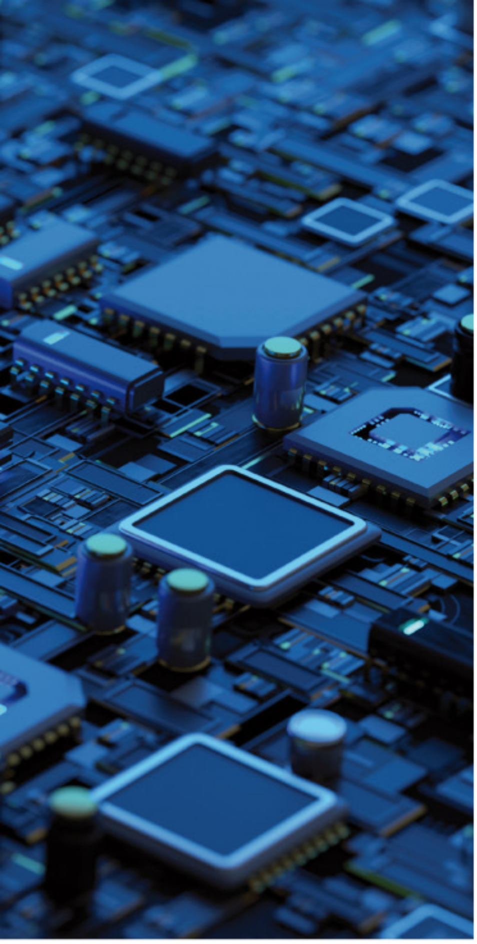
Inside, all of these chips are built on TSMC's N4X process. Despite the name, this is officially a 5nm process, but it features enhancements that, TSMC claims, boost performance by up to 15% compared to the original 5nm process used for Zen 4.

> **What makes Zen 5 special is that it's the first mainstream core that can work two steps ahead**

Another advantage of Zen 5 chips is new branch prediction logic. Branch prediction is a CPU feature that tries to speed up code execution by anticipating what will happen after the current instruction, and presumptively starting to load in and work on the expected next instruction before it's needed. All modern processors use branch prediction, but what makes Zen 5 special is that it's the first mainstream core from any manufacturer that can actually work two steps in advance.

To enable the core to work so far ahead, Zen 5-based chips also include more ultra-high-speed cache than previous AMD processors, with the L1 cache being increased from 64KB per core to 80KB. The standard L2 cache remains at 1MB per core, as it was in Zen 4, while L3 cache varies depending on the chip model.

The Zen 5 core also features six arithmetic logic units, up from four in previous models – boosting mathematical performance by up to 50% – plus an expanded vector engine that can speed up processing of large data arrays, including AI-type workloads. For those wanting to use the very fastest memory modules, Zen 5 also supports DDR5-5600 – a modest increase from the maximum DDR5-5200 supported by Zen 4.



What's next for AMD?

Zen 5 is fairly new, with the first mobile chips appearing in June 2024 and new models last month. Based on previous upgrade cycles, we don't expect Zen 6 (codenamed Morpheus) to make its debut until next year.

AMD hasn't officially announced what enhancements might be included in the next core, but leaks suggest it will increase the maximum number of cores per chip. This means we could see desktop chips with as many as 24 physical cores, along with 96MB of L3 cache as standard. However, there are no major platform changes on the horizon, and Zen 6 is expected to stick with the established Socket AM5 interface.

Intel

Last month, we described a generation of processors as a family of chips all based on the same core design. That's generally true, but recent years have seen Intel race through updates to its manufacturing processes in a bid to remain competitive – and as a result, its current processor line-up, branded as second-generation Core and Core Ultra chips, actually takes in three different cores across a total of 47 different CPU models.

That includes seven processors using the "Raptor Lake Refresh" core, a refinement of the Raptor Lake architecture introduced in 2022 for the 13th- and 14th-generation Core i CPUs. A further 32 models are based on Arrow Lake, a newer design aimed at desktops and high-end laptops, while the remaining nine chips are built on Lunar Lake, a mobile-only core with a focus on power efficiency.

To help make sense of the situation, most model numbers have suffixes that explain the chip's profile. On the desktop side, the "K" suffix indicates a top-performance chip with unlocked multipliers, while "T" denotes a desktop processor designed for lower power consumption. "F" indicates a chip with no GPU. For mobile processors, "H" means a high-performance design, while "HX" is a high-end chip that also includes Intel's vPro management technology. "U" processors are more power-efficient, while "V" denotes a chip using the unique Lunar Lake architecture, discussed below.

As usual, the distinctions between different chip models partly boil down to the number and speed of CPU and GPU cores, and the amount of cache memory embedded on the chip. Unlike older Intel CPUs, all second-generation Core processors use a mixture of high-performance "P-cores" and energy-efficient "E-cores", so there's plenty of scope to tune different chips for different balances of power and performance.

For future chips, Intel will be returning to in-house manufacturing

With three different cores in the mix, however, the differences run deeper. For example, chips based on Arrow Lake all include a lightweight NPU rated at 12 or 13 TOPS, while the older Raptor Lake Refresh lacks specialised AI hardware. Conversely, Raptor Lake chips use Hyper-Threading technology in their P-cores, allowing them to handle two execution threads at once – a capability removed from the latest processors in the name of efficiency.

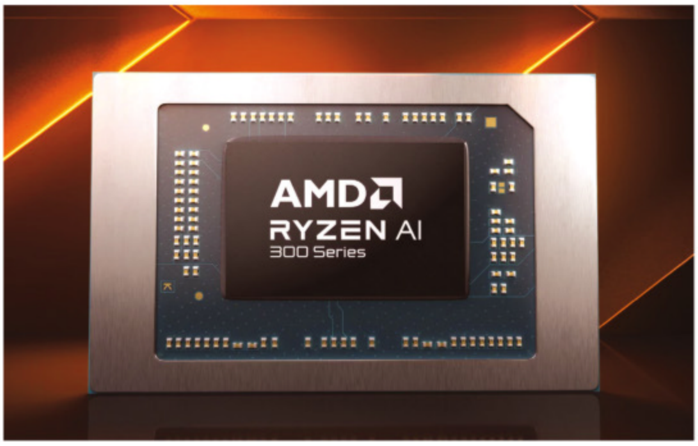
Lunar Lake, meanwhile, has a very different design, including an NPU of at least 40 TOPS that qualifies for Microsoft's "Copilot+ PC" branding. Lunar Lake chips also break with tradition by including either 16GB or 32GB of integrated (non-upgradable) system RAM on the processor itself – and these chips also have the distinction of being the only Intel chips ever to be manufactured by a third party, in this case TSMC. That's a one-off, however: for future chips, Intel will be returning to in-house manufacturing, and also intends to go back to using outboard DIMMs rather than on-package memory.

Finally, it's worth noting that different chip models also have different GPU components. For the most part, you'll find between three and eight Intel Xe graphics cores on the chip, but Raptor Lake models use the older Intel UHD Graphics cores, with 48, 64, 80 or 96 execution units; we've marked these with asterisks in the table, as they're not comparable to the Xe cores.

What's next for Intel?

Later this year Intel is expected to launch a range of "Arrow Lake

BELOW AMD's Zen 5 chips include extra ultra-high-speed cache.
BOTTOM Seven Intel chips use the Raptor Lake Refresh core.



i9
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CPU GENERATIONS

AMD

Model number	Platform	Physical cores	Threads	Base clock	Boost clock	GPU cores	GPU clock (max)	NPU	L1 cache	L2 cache	L3 cache	Codename	Process size	Release date
Ryzen 9 9950X3D	Desktop	16	32	4.3GHz	5.7GHz	2	2.2GHz	None	1,280KB	16MB	128MB	Granite Ridge	5nm	March 2025
Ryzen 9 9950X	Desktop	16	32	4.3GHz	5.7GHz	2	2.2GHz	None	1,280KB	16MB	64MB	Granite Ridge	5nm	August 2024
Ryzen 9 9900X3D	Desktop	12	24	4.4GHz	5.5GHz	2	2.2GHz	None	960KB	12MB	128MB	Granite Ridge	5nm	March 2025
Ryzen 9 9900X	Desktop	12	24	4.4GHz	5.6GHz	2	2.2GHz	None	960KB	12MB	64MB	Granite Ridge	5nm	August 2024
Ryzen 7 9800X3D	Desktop	8	16	4.7GHz	5.2GHz	2	2.2GHz	None	640KB	8MB	96MB	Granite Ridge	5nm	November 2024
Ryzen 7 9700X	Desktop	8	16	3.8GHz	5.5GHz	2	2.2GHz	None	640KB	8MB	32MB	Granite Ridge	5nm	August 2024
Ryzen 5 9600X	Desktop	6	12	3.9GHz	5.4GHz	2	2.2GHz	None	480KB	6MB	32MB	Granite Ridge	5nm	August 2024
Ryzen 5 9600	Desktop	6	12	3.8GHz	5.2GHz	2	2.2GHz	None	480KB	6MB	32MB	Granite Ridge	5nm	TBC
Ryzen AI MAX+ (PRO) 395	Mobile	16	32	3GHz	5.1GHz	40	2.9GHz	50 TOPS	1,280KB	16MB	64MB	Strix Halo	5nm	March 2025
Ryzen AI MAX (PRO) 390	Mobile	16	32	3.2GHz	5GHz	32	2.8GHz	50 TOPS	1,280KB	16MB	64MB	Strix Halo	5nm	March 2025
Ryzen AI MAX (PRO) 385	Mobile	8	16	3.6GHz	5GHz	32	2.8GHz	50 TOPS	640KB	8MB	32MB	Strix Halo	5nm	March 2025
Ryzen AI MAX PRO 380	Mobile	6	12	3.6GHz	4.9GHz	16	2.8GHz	50 TOPS	480KB	6MB	16MB	Strix Halo	5nm	March 2025
Ryzen 9 9955HX3D	Mobile	16	32	2.3GHz	5.4GHz	2	2.2GHz	None	1,280KB	16MB	128MB	Fire Range	5nm	March 2025
Ryzen 9 9955HX	Mobile	16	32	2.5GHz	5.4GHz	2	2.2GHz	None	1,280KB	16MB	64MB	Fire Range	5nm	March 2025
Ryzen 9 9850HX	Mobile	12	24	3GHz	5.2GHz	2	2.2GHz	None	960KB	12MB	64MB	Fire Range	5nm	March 2025
Ryzen AI 9 (PRO) HX375	Mobile	12	24	2GHz	5.1GHz	16	2.9GHz	55 TOPS	960KB	12MB	24MB	Strix Point	5nm	June 2024
Ryzen AI 9 (PRO) HX370	Mobile	12	24	2GHz	5.1GHz	16	2.9GHz	50 TOPS	960KB	12MB	24MB	Strix Point	5nm	June 2024
Ryzen AI 9 HX365	Mobile	10	20	2GHz	5GHz	12	2.9GHz	50 TOPS	800KB	10MB	24MB	Strix Point	5nm	June 2024
Ryzen AI 7 PRO 360	Mobile	8	16	2GHz	5GHz	12	2.9GHz	50 TOPS	640KB	8MB	16MB	Strix Point	5nm	October 2024
Ryzen AI 7 (PRO) 350	Mobile	8	16	2GHz	5GHz	8	3GHz	50 TOPS	640KB	8MB	16MB	Strix Point	5nm	March 2025
Ryzen AI 7 (PRO) 340	Mobile	6	12	2GHz	4.8GHz	4	2.9GHz	50 TOPS	480KB	6MB	16MB	Strix Point	5nm	March 2025

INTEL

Model number	Platform	P-cores	P-core base clock	P-core maximum boost	E-cores	E-core base clock	E-core maximum boost	Integrated RAM	GPU cores	GPU clock (max)	NPU	L1 cache	L2 cache	Smart cache	Codename	Process size	Release date
Core Ultra 9 285K	Desktop	8	4.3GHz	5.7GHz	16	3.2GHz	4.6GHz	None	4	2GHz	13 TOPS	2.4MB	40MB	36MB	Arrow Lake-S	3nm	October 2024
Core Ultra 9 285	Desktop	8	2.5GHz	5.6GHz	16	1.9GHz	4.6GHz	None	4	2GHz	13 TOPS	2.4MB	40MB	36MB	Arrow Lake-S	3nm	January 2025
Core Ultra 9 285T	Desktop	8	1.4GHz	5.4GHz	16	1.2GHz	4.6GHz	None	4	2GHz	13 TOPS	2.4MB	40MB	36MB	Arrow Lake-S	3nm	October 2024
Core Ultra 7 265K	Desktop	8	3.9GHz	5.5GHz	12	3.3GHz	4.6GHz	None	4	2GHz	13 TOPS	2MB	36MB	30MB	Arrow Lake-S	3nm	October 2024
Core Ultra 7 265KF	Desktop	8	3.9GHz	5.5GHz	12	3.3GHz	4.6GHz	None	None	N/A	13 TOPS	2MB	36MB	30MB	Arrow Lake-S	3nm	October 2024
Core Ultra 7 265	Desktop	8	2.4GHz	5.3GHz	12	1.8GHz	4.6GHz	None	4	1.95GHz	13 TOPS	2MB	36MB	30MB	Arrow Lake-S	3nm	January 2025
Core Ultra 7 265F	Desktop	8	2.4GHz	5.3GHz	12	1.8GHz	4.6GHz	None	None	N/A	13 TOPS	2MB	36MB	30MB	Arrow Lake-S	3nm	January 2025
Core Ultra 7 265T	Desktop	8	1.5GHz	5.3GHz	12	1.2GHz	4.6GHz	None	4	1.95GHz	13 TOPS	2MB	36MB	30MB	Arrow Lake-S	3nm	January 2025
Core Ultra 5 245K	Desktop	6	4.2GHz	5.2GHz	8	3.6GHz	4.6GHz	None	4	1.9GHz	13 TOPS	1.4MB	26MB	24MB	Arrow Lake-S	3nm	October 2024
Core Ultra 5 245KF	Desktop	6	4.2GHz	5.2GHz	8	3.6GHz	4.6GHz	None	None	N/A	13 TOPS	1.4MB	26MB	24MB	Arrow Lake-S	3nm	October 2024
Core Ultra 5 245	Desktop	6	3.5GHz	5.1GHz	8	3GHz	4.5GHz	None	4	1.9GHz	13 TOPS	1.4MB	26MB	24MB	Arrow Lake-S	3nm	January 2025
Core Ultra 5 245T	Desktop	6	2.2GHz	5.1GHz	8	1.7GHz	4.5GHz	None	4	1.9GHz	13 TOPS	1.4MB	26MB	24MB	Arrow Lake-S	3nm	January 2025
Core Ultra 5 235	Desktop	6	3.4GHz	5GHz	8	2.9GHz	4.4GHz	None	3	2GHz	13 TOPS	1.4MB	26MB	24MB	Arrow Lake-S	3nm	January 2025
Core Ultra 5 235T	Desktop	6	2.2GHz	5GHz	8	1.6GHz	4.4GHz	None	3	2GHz	13 TOPS	1.4MB	26MB	24MB	Arrow Lake-S	3nm	January 2025

Core Ultra 5 225	Desktop	6	3.3GHz	4.9GHz	4	2.7GHz	4.4GHz	None	2	1.8GHz	13 TOPS	1MB	22MB	20MB	Arrow Lake-S	3nm	January 2025
Core Ultra 5 225F	Desktop	6	3.3GHz	4.9GHz	4	2.7GHz	4.4GHz	None	None	N/A	13 TOPS	1MB	22MB	20MB	Arrow Lake-S	3nm	January 2025
Core Ultra 5 225T	Desktop	6	2.5GHz	4.9GHz	4	1.9GHz	4.4GHz	None	2	1.8GHz	13 TOPS	1MB	22MB	20MB	Arrow Lake-S	3nm	January 2025
Core Ultra 7 265U	Mobile	2	2.1GHz	5.3GHz	8	1.7GHz	4.2GHz	None	4	2.1GHz	12 TOPS	1MB	8MB	12MB	Arrow Lake-U	3nm	January 2025
Core Ultra 7 255U	Mobile	2	2GHz	5.2GHz	8	1.7GHz	4.2GHz	None	4	2.1GHz	12 TOPS	1MB	8MB	12MB	Arrow Lake-U	3nm	January 2025
Core Ultra 5 235U	Mobile	2	2GHz	4.9GHz	8	1.6GHz	4.1GHz	None	4	2.05GHz	12 TOPS	1MB	8MB	12MB	Arrow Lake-U	3nm	January 2025
Core Ultra 5 225U	Mobile	2	1.5GHz	4.8GHz	8	1.3GHz	3.8GHz	None	4	2GHz	12 TOPS	1MB	8MB	12MB	Arrow Lake-U	3nm	January 2025
Core 7 250U	Mobile	2 (4)	1.8GHz	5.4GHz	8	1.2GHz	4GHz	None	96*	1.3GHz	None	1MB	8MB	12MB	Raptor Lake-U Refresh	3nm	January 2025
Core 5 220U	Mobile	2 (4)	1.4GHz	5GHz	8	900MHz	3.8GHz	None	80*	1.3GHz	None	1MB	8MB	12MB	Raptor Lake-U Refresh	3nm	January 2025
Core Ultra 9 288V	Mobile	4	3.3GHz	5.1GHz	4	3.3GHz	3.7GHz	32GB	8	2.05GHz	48 TOPS	832	14MB	12MB	Lunar Lake	3nm	September 2024
Core Ultra 7 268V	Mobile	4	2.2GHz	5GHz	4	2.2GHz	3.7GHz	32GB	8	2GHz	48 TOPS	832	14MB	12MB	Lunar Lake	3nm	September 2024
Core Ultra 7 266V	Mobile	4	2.2GHz	5GHz	4	2.2GHz	3.7GHz	16GB	8	2GHz	48 TOPS	832	14MB	12MB	Lunar Lake	3nm	September 2024
Core Ultra 7 258V	Mobile	4	2.2GHz	4.8GHz	4	2.2GHz	3.7GHz	32GB	8	1.95GHz	47 TOPS	832	14MB	12MB	Lunar Lake	3nm	September 2024
Core Ultra 7 256V	Mobile	4	2.2GHz	4.8GHz	4	2.2GHz	3.7GHz	16GB	8	1.95GHz	47 TOPS	832	14MB	12MB	Lunar Lake	3nm	September 2024
Core Ultra 5 238V	Mobile	4	2.1GHz	4.7GHz	4	2.1GHz	3.5GHz	32GB	7	1.85GHz	40 TOPS	832	14MB	12MB	Lunar Lake	3nm	September 2024
Core Ultra 5 236V	Mobile	4	2.1GHz	4.7GHz	4	2.1GHz	3.5GHz	16GB	7	1.85GHz	40 TOPS	832	14MB	12MB	Lunar Lake	3nm	September 2024
Core Ultra 5 228V	Mobile	4	2.1GHz	4.5GHz	4	2.1GHz	3.5GHz	32GB	7	1.85GHz	40 TOPS	832	14MB	12MB	Lunar Lake	3nm	September 2024
Core Ultra 5 228V	Mobile	4	2.1GHz	4.5GHz	4	2.1GHz	3.5GHz	16GB	7	1.85GHz	40 TOPS	832	14MB	12MB	Lunar Lake	3nm	September 2024
Core 9 270H	Mobile	6 (12)	2.7GHz	5.8GHz	8	2GHz	4.1GHz	None	96*	1.55GHz	None	1.2MB	11.5MB	24MB	Raptor Lake-H Refresh	3nm	December 2024
Core 7 250H	Mobile	6 (12)	2.5GHz	5.4GHz	8	1.8GHz	4GHz	None	96*	1.55GHz	None	1.2MB	11.5MB	24MB	Raptor Lake-H Refresh	3nm	December 2024
Core 7 240H	Mobile	6 (12)	2.5GHz	5.2GHz	4	1.8GHz	4GHz	None	64*	1.55GHz	None	1MB	9.5MB	24MB	Raptor Lake-H Refresh	3nm	December 2024
Core 5 220H	Mobile	4 (8)	2.7GHz	4.9GHz	8	2GHz	3.7GHz	None	80*	1.5GHz	None	1.2MB	18MB	18MB	Raptor Lake-H Refresh	3nm	December 2024
Core 5 210H	Mobile	4 (8)	2.2GHz	4.8GHz	4	1.6GHz	3.6GHz	None	48*	1.4GHz	None	832KB	14MB	12MB	Raptor Lake-H Refresh	3nm	December 2024
Core Ultra 9 285H	Mobile	6	2.9GHz	5.4GHz	8	2.7GHz	4.5GHz	None	8	2.35GHz	13 TOPS	1.4MB	23MB	24MB	Arrow Lake-H	3nm	January 2025
Core Ultra 7 265H	Mobile	6	2.2GHz	5.3GHz	8	1.7GHz	4.5GHz	None	8	2.3GHz	13 TOPS	1.4MB	23MB	24MB	Arrow Lake-H	3nm	January 2025
Core Ultra 7 255H	Mobile	6	2GHz	5.1GHz	8	1.5GHz	4.4GHz	None	8	2.25GHz	13 TOPS	1.4MB	23MB	24MB	Arrow Lake-H	3nm	January 2025
Core Ultra 5 235H	Mobile	4	2.4GHz	5GHz	8	1.5GHz	4.4GHz	None	8	2.25GHz	13 TOPS	1.2MB	18MB	24MB	Arrow Lake-H	3nm	January 2025
Core Ultra 5 225H	Mobile	4	1.7GHz	4.9GHz	8	1.3GHz	4.3GHz	None	7	2.2GHz	13 TOPS	1.2MB	18MB	24MB	Arrow Lake-H	3nm	January 2025
Core Ultra 9 285HX	Mobile	8	2.8GHz	5.5GHz	16	2.1GHz	4.6GHz	None	4	2GHz	13 TOPS	2.4MB	36MB	36MB	Arrow Lake-HX	3nm	January 2025
Core Ultra 9 275HX	Mobile	8	2.7GHz	5.4GHz	16	2.1GHz	4.6GHz	None	4	1.9GHz	13 TOPS	2.4MB	36MB	36MB	Arrow Lake-HX	3nm	January 2025
Core Ultra 7 265HX	Mobile	8	2.6GHz	5.3GHz	12	2.3GHz	4.6GHz	None	4	1.9GHz	13 TOPS	2MB	32MB	30MB	Arrow Lake-HX	3nm	January 2025
Core Ultra 7 255HX	Mobile	8	2.4GHz	5.2GHz	12	1.8GHz	4.5GHz	None	4	1.85GHz	13 TOPS	2MB	32MB	30MB	Arrow Lake-HX	3nm	January 2025
Core Ultra 5 245HX	Mobile	6	3.1GHz	5.1GHz	8	2.6GHz	4.5GHz	None	3	1.9GHz	13 TOPS	1.4MB	23MB	24MB	Arrow Lake-HX	3nm	January 2025
Core Ultra 5 235HX	Mobile	6	2.9GHz	5.1GHz	8	2.6GHz	4.5GHz	None	3	1.9GHz	13 TOPS	1.4MB	23MB	24MB	Arrow Lake-HX	3nm	January 2025

APPLE

Model number	Platform	P-cores	P-core maximum clock	E-cores	E-core maximum clock	Integrated RAM	GPU cores	GPU clock (max)	NPU	L1 cache	L2 cache	Process size	Release date
M3	Desktop & mobile	4	4.05GHz	4	2.75GHz	8GB/16GB/24GB	8/9/10	1.4GHz	18 TOPS	320KB per P-core + 192KB per E-core	20MB	3nm	November 2023
M3 Ultra	Desktop & mobile	20/24	4.05GHz	8	2.75GHz	96GB/128GB/256GB/512GB	60	1.47GHz	36 TOPS	320KB per P-core + 192KB per E-core	68MB	3nm	March 2025
M4	Desktop & mobile	3/4	4.4GHz	4/6	2.85GHz	8GB/16GB/24GB/32GB	8/10	1.47GHz	38 TOPS	320KB per P-core + 192KB per E-core	20MB	3nm	May 2024
M4 Pro	Desktop & mobile	8/10	4.5GHz	4	2.85GHz	24GB/48GB/64GB	16/20	1.58GHz	38 TOPS	320KB per P-core + 192KB per E-core	36MB	3nm	November 2024
M4 Max	Desktop & mobile	10/12	4.5GHz	4	2.85GHz	32GB/48GB/64GB/128GB	32/40	1.58GHz	38 TOPS	320KB per P-core + 192KB per E-core	36MB	3nm	November 2024

Refresh" chips, which will be marketed as the Core Ultra 300 series for both desktop and mobile systems. Going by previous "Refresh" launches, these chips will probably use the same core design as existing Arrow Lake chips, but with upgrades such as faster clock speeds and an improved NPU.

After that we can look forward to a completely new core codenamed "Panther Lake"; early silicon is expected to be showcased before the end of 2025, with mass production to follow in the first quarter of next year. The cautious timetable is because this will be the company's first 18A chip, representing a process size of 18 angstroms or 1.8nm – rivalling the smallest chips available from TSMC or any other foundry.

Technical details are still under wraps, but it's predicted that Panther Lake will be up to 13% faster than Arrow Lake, and could have as much as 120 TOPS of AI performance. If you're looking for a powerful AI laptop, therefore, it might be worth holding out until the next generation – but remember that these dates and features aren't officially confirmed.

Apple

Compared to the massive table of different Intel CPUs, Apple's lineup is refreshingly simple. Leaving aside the A-series processors in iPhones and a few other Apple gadgets, there are only five main chip models in use across almost every laptop and desktop in Apple's range. Two of these are pretty rare, too: the M3 and M3 Ultra are found only in the latest iPad Air and the top-spec Mac Studio respectively. If you buy any other Apple computer (or iPad Pro) today, you're getting the M4 chip, or a variant thereof.

The M4 isn't much of a change from the M3, and it's manufactured by TSMC on the same 3nm process. However, clock speeds are a little higher for both the CPU and GPU, and the newer chip has 20% more memory bandwidth, allowing it to tear through data at up to 120Gbits/sec. It also features a greatly souped-up NPU that's over twice as powerful as the M3's Neural Engine.

All of Apple's M-series processors include both P-cores and E-cores, like Intel's latest chips – but, unlike Intel, the system RAM is always built into the chip, too, so each model comes in a few variants to support different memory requirements.

M4
M4 PRO
M4 MAX

ABOVE Apple's M4 chips are found in almost all of its laptop and desktop computers.

Another difference between Apple and other chip makers is that the same processor models are used in both laptop and desktop computers, with generally similar clock speeds across the range. The company may however tweak the number of CPU and GPU cores to suit different roles: for example, the iPad Pro and the MacBook Air both use the M4 processor, but the version used in the iPad Pro has nine CPU cores and ten GPU cores, while entry-level MacBook Air laptops have ten CPU cores but only eight GPU cores. MacBook Pro models, meanwhile, get ten of each core, plus an active cooling system that helps the chip achieve peak performance.

Then there are the M4 Pro and M4 Max models; these are built on the same core logic as the M4, but are engineered with more cores than the standard models can support.

> **Apple's most powerful Ultra chips are in effect two entire dies connected together**

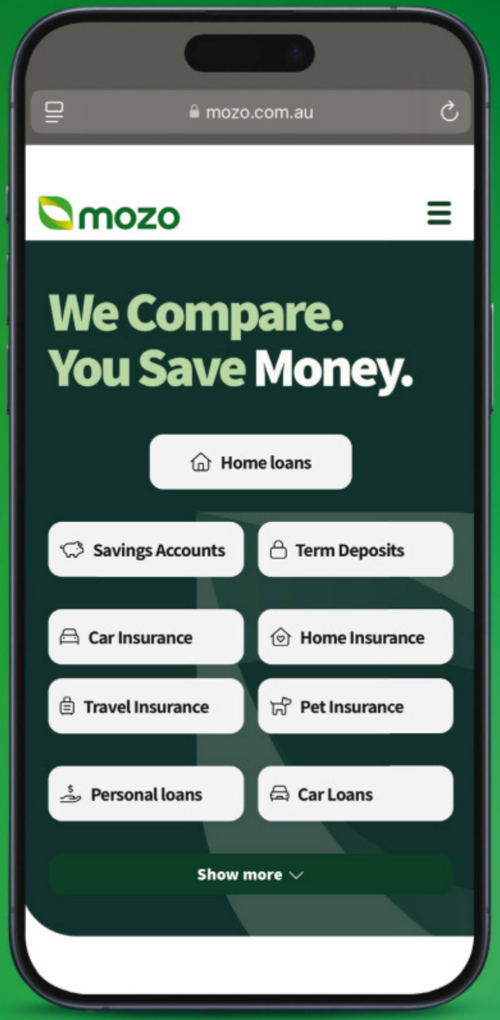
Some additional features such as Thunderbolt 5 and 10Gbits/sec Ethernet are only offered on machines with M4 Pro or Max chips, although this is a marketing decision rather than a feature of the chips themselves.

Apple's most powerful chips are its Ultra processors, which are in effect two entire dies connected together, giving you twice the cores, cache and RAM of a standard model. Apple isn't yet offering an M4 Ultra processor, so for now its top-of-the-line Mac Studio systems are based on the M3 Ultra – a chip that can still comfortably outpace any available M4 model.

What's next for Apple?

Apple is secretive about unreleased products, but it's a reasonable guess that the M4 family will be succeeded by an M5 generation of processors, probably before the end of the year.

As to what will changes these chips will bring, rumours are of a modest, incremental upgrade; it's the subsequent M6 processor that's expected to bring significant boosts to performance and power efficiency, partly thanks to a switch to a 2nm process. This doesn't necessarily you should skip the M5 generation, though: it should still bring advantages over the M4, and might come alongside other platform changes such as the introduction of Thunderbolt 5 for entry-level systems or support for Wi-Fi 7. ■


mozo.com.au
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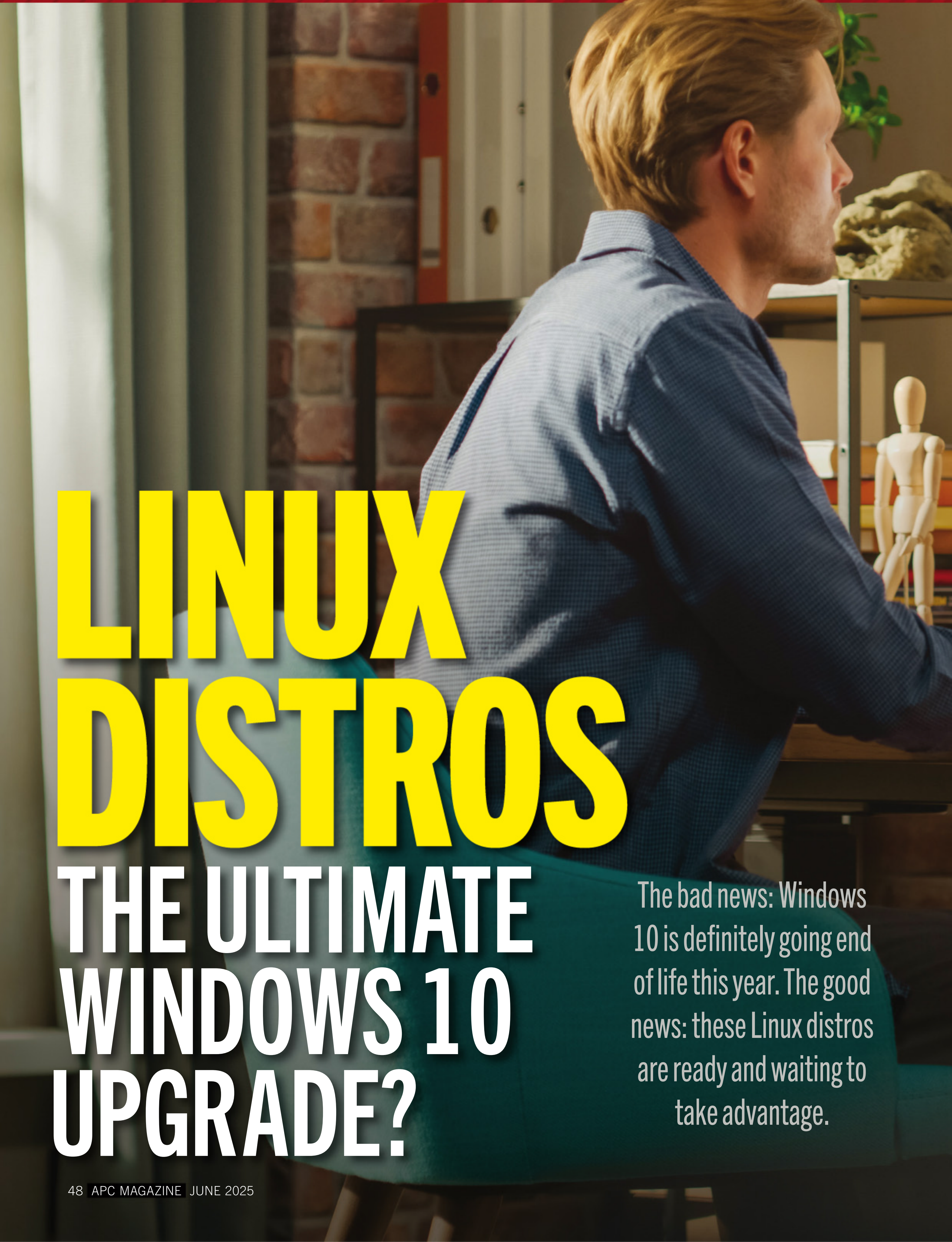

LINUX DISTROS

THE ULTIMATE WINDOWS 10 UPGRADE?

The bad news: Windows 10 is definitely going end of life this year. The good news: these Linux distros are ready and waiting to take advantage.

Sublime
linuxmint
New Features
Linux Mint 22.1
Modernization of APT dependencies

Despite its success in the server space, Linux runs on a minority of desktops. Windows machines outnumbered Linux by 20 devices to one. But, we believe its future looks bright.

Its user base has grown enormously over the last year, and it's on course to touch 5% of all desktops in the first quarter of 2025. This isn't surprising. The increasing popularity of single-board computers like Raspberry Pi is putting Linux into the hands of a whole new generation of users while computers are lasting longer than ever before,

Combine hardware longevity with Microsoft's desire to end support for Windows 10 – it goes end of life on 14 October – and you have two excellent reasons to consider a switch to Linux.

To put this thought to the test, we bought a second-hand Dell OptiPlex 3060 specifically for this Labs. With an Intel Core i5-8500T processor, integrated graphics, 8GB of memory and a 256GB SSD, it's no longer cutting edge, but it's precisely the kind of machine that would suit a first-time Linux user well.

Buying second hand means you can choose a Linux workstation that exactly suits your requirements, and it also reduces your environmental impact. The costliest periods of a computer's lifecycle, from an ecological perspective, are when it's produced and disposed of. The longer you can keep one running between those two moments, the lighter the carbon footprint will be when averaged across the years.

Encouraging someone to switch to Linux on environmental grounds used to mean an acknowledgment that doing so involved making some compromises. In particular, usability and functionality. That's no longer true. Linux is flexible, fast and easy to use, and with more and more applications running in the cloud, the times when you can't do what you need will be fewer – and definitely far between.

Don't believe us? Download one of these eight distributions and see for yourself.

CONTRIBUTOR **Nik Rawlinson**

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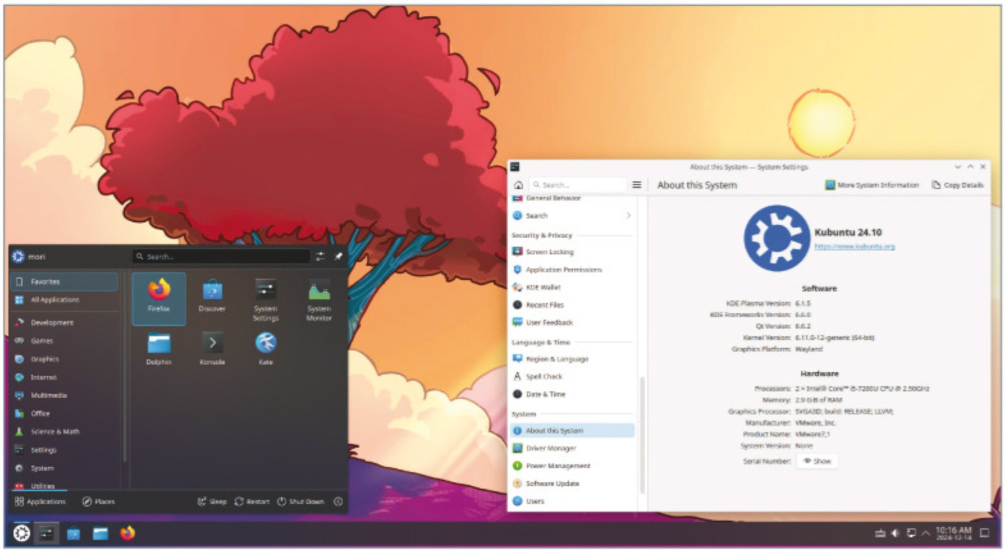
What is a Linux distribution anyway?

Linux works in a quite different way to Windows, so to make an informed choice you need to understand how all the components of a distribution fit together.


Firefox
Discover
System Settings
System Monitor
Dolphin
Konsole
Kate
Favorites
All Applications
Development
Games
Graphics
Internet
Multimedia
Office
Science & Math
Settings
System
Utilities
Applications
Places
Sleep
Restart
Shut Down
About this System — System Settings
About this System
More System Information
Copy Details
General Behavior
Search
Security & Privacy
Screen Locking
Application Permissions
KDE Wallet
Recent Files
User Feedback
Language & Time
Region & Language
Spell Check
Date & Time
System
About this System
Driver Manager
Power Management
Software Update
Users
10:16 AM

Kubuntu 24.10

https://www.kubuntu.org

Software

KDE Plasma Version: 6.1.5
KDE Frameworks Version: 6.6.0
Qt Version: 6.6.2
Kernel Version: 6.11.0-12-generic (64-bit)
Graphics Platform: Wayland

Hardware

Processors: 2 × Intel® Core™ i5-7200U CPU @ 2.50GHz
Memory: 2.9 GiB of RAM
Graphics Processor: SVGA3D; build: RELEASE; LLVM;
Manufacturer: VMware, Inc.
Product Name: VMware7,1
System Version: None
Serial Number: Show

ABOVE Ubuntu is available with a range of environments, including KDE.

If you're coming from Windows or macOS, where the operating system name is all you need to know, you might be wondering what exactly a Linux distribution is, how a display server differs from a desktop environment, and where apps and packages fit into the mix.

A distribution – often shortened to distro – is the overarching operating system, including the kernel, the graphical interface, the code that interfaces between different hardware elements and so on. As such, while we might consider Ubuntu, Fedora, Mint and the like to be "distros", your Ubuntu distro might be significantly different to ours.

Desktop environment

Unless you spend a lot of time working at the Terminal, most of your interaction will be through the desktop environment. In Windows, that would be the Windows Shell, which manages the operating system's graphical front end. Linux brands will frequently guide you towards their preferred environment – Gnome for Fedora, KDE for Manjaro, Cinnamon for Linux Mint – but it's rare that you can't switch to another if you prefer. Ubuntu alone is available with KDE (as Kubuntu), LXQt (as Lubuntu), Budgie, Mate, Cinnamon, Xfce and others. So, if you're switching from one distribution to another, there's no reason why your new operating system can't look and behave very like the one you're leaving behind.

But the desktop environment is only half of the story. The "environment" is effectively a series of packages that define the look of panels, onscreen buttons, window borders and so on. It can't directly interface with the screen on which they'll be displayed. Rather, it hands off what it's produced to the graphical server, which is sometimes also referred to as the display server. This takes the data from the desktop environment and arranges it on the screen, while also receiving input from the mouse and keyboard.

For many years you'd be unlikely to come across any graphical server other than X11, but that's changing. X11 first appeared in the 1980s, since when hardware has undergone several significant changes. Over time, therefore, X11 has been added to, as a result of which it has become more complex. Not so with Wayland, which looks increasingly like becoming its logical replacement. Wayland first appeared around 16 years ago and is simpler, so should exhibit lower latency. It's not fully supported by all applications, which is why X11 remains the default on some distributions, while others allow you to switch between the two.

If most of your time will be spent interacting with its graphical front end, it doesn't really matter how it's delivered

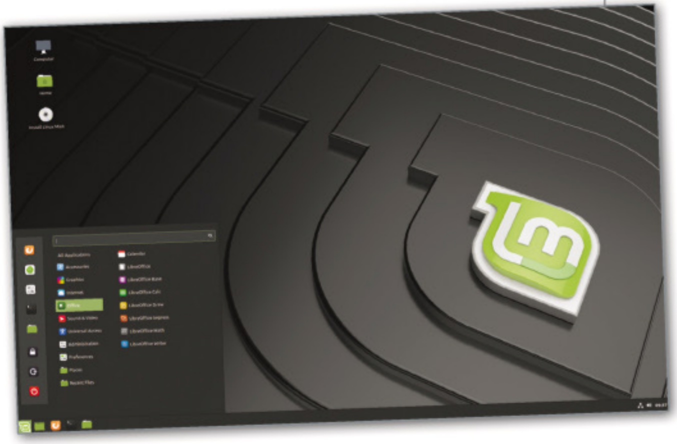
Putting it all together

If you're having trouble visualising how everything fits together, imagine a school art room. The room itself is analogous to a Linux distribution, as it has easels, tables, chairs, lighting, tools and materials – and everything else required to conduct an art lesson, all contained in a single location. Within it sits the canvas, on an easel. As the medium on which the artwork will be hosted, we can liken the canvas to the graphical server. It's not the artwork itself, but an essential facilitator. Without it, there would be no art.

Finally, there's the artwork, which the students will produce on the canvas, using the brushes and so on present in the room. The desktop environment is like a style guide for this artwork, which strongly influences how the tools are used to produce the end product. The end result might look like a Picasso or a Mondrian, or something entirely original. That doesn't really matter: scrape away the surface and there's still a canvas underneath.

It doesn't really matter what the art room looks like, what language the teacher speaks, how old the students are or what materials they use. All that matters is the end product, and whether you, as the viewer, like the look of it. The same is true of a distribution. If most of your time will be spent interacting with its graphical front end, it doesn't really matter how it's delivered so long as the overall distribution is secure and it gives you access to the apps you need.

BELOW Cinnamon is the preferred environment for Linux Mint.



		RECOMMENDED	RECOMMENDED					LABS WINNER
	ElementaryOS	Fedora Workstation	Linux Mint	Manjaro	MX Linux	openSUSE Tumbleweed	Pop!_OS	Ubuntu Desktop 24.10
Overall rating	★★★☆☆	★★★★★	★★★★☆	★★★☆☆	★★★☆☆	★★★★☆	★★★★☆	★★★★★
Download from	elementary.io	fedoraproject.org	linuxmint.com	manjaro.org	mxlinux.org	get.opensuse.org	pop.system76.com	ubuntu.com
Tested version	8.0	41	22.1	24.2	23.5	Updated daily	22.04	24.10
Release date	November 2024	October 2024	January 2025	December 2024	January 2025	On day of download	April 2022	October 2024
Technical details								
Release model	Periodic	Rolling updates	Periodic	Rolling updates	Periodic	Rolling release	Periodic	Periodic
Family	Debian	Red Hat	Debian	Arch	Debian	SUSE	Debian	Debian
Architecture	x86_64	x86_64, aarch64, ppc64le	x86_64 (i686 support for LDME edition)	x86_64	x86_64, i686	x86_64, 9686, ppc64le, aarch64, s390x	x86_64, Raspberry Pi (as tech preview)	x86_64, Arm64, ppc64le, s390x
Editions	Desktop	Desktop, server, IoT, cloud, container	Desktop	Desktop, phone/ embedded	Desktop	Desktop, server	Desktop	Desktop, server, core, cloud
Linux kernel	6.8	6.11	6.8	6.12	6.1	Latest available kernel at point of download	6.9	6.11
Download size	3.2GB	2.3GB	2.8GB	4GB	2.2GB	4.3GB	2.48GB	5.3GB
Installer	Custom based on Ubiquity	Anaconda	Ubiquity	Calamares	Custom	YaST	Custom	Ubiquity
Desktops	Pantheon	Gnome, KDE Plasma, Cinnamon, Mate, Xfce	Cinnamon, Xfce, Mate	KDE Plasma, Xfce, Gnoma, Cinnamon, i3 Window Manager, Sway VM	Xfce, Plasma, Fluxbox	KDE Plasma, Gnome, Xfce, IceWM, Cinnamon, Mate, Pantheon	Cosmic	Gnome (alternative desktops available from affiliated projects)
End of support	Underlying Ubuntu 24.04 LTS supported until 2029	13 months after release	April 2029	No end date as this is a rolling release	June 2026	No end date as this is a rolling release	April 2027	July 2025
Geekbench 6 results								
Single core	1,169	1,121	1,166	1,217	1,240	1,215	1,161	1,152
Multicore	3,969	3,185	3,991	3,957	4,078	3,962	3,954	3,543
Requirements								
CPU	Core i3 or comparable dual-core 64-bit processor	Not stated	Not stated	Dual core	i686 or later	2GHz dual core	64-bit	2GHz dual core
Memory	4GB	4GB	4GB	4GB	2GB	2GB	4GB	4GB
Storage	32GB	40GB	100GB	30GB	20GB	40GB	16GB	25GB
Display	1,024 x 768 resolution display	No minimum requirement specified	1,024 x 768 resolution display	High-definition graphics card and monitor	3D-capable video card (no minimum resolution specified)	No minimum requirement specified	No minimum requirement specified	No minimum requirement specified

How to install Linux

Whether this is the first time you've installed a Linux distro or you're a veteran, our step-by-step guide provides all the information you need.

Most Linux distributions are free to download and install. All you need to get started is an ISO and a thumb drive to host the installer.

1. DOWNLOAD BALENAETCHER

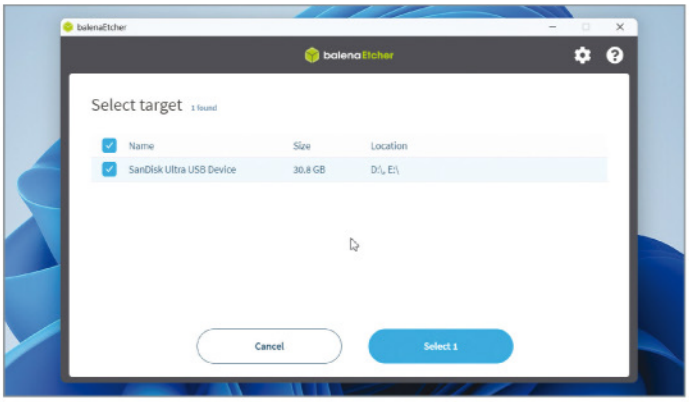
Install BalenaEtcher from **etcher.balena.io**. Once you've decided which version of Linux you want to install, download an ISO of its desktop, workstation or client edition. Frequently, each will be available for a variety of processor architectures, so make sure you choose the appropriate distribution for your PC, which will almost certainly be marked as x86_64, x86-64 or AMD64.

2. SELECT THE DISTRO AND DRIVE

Plug in your USB thumb drive and, once it's mounted, switch to BalenaEtcher. Click "Flash from file" and select the ISO you downloaded in the previous step. Next, click "Select target" and choose your USB thumb drive. Note that it's possible to select multiple drives simultaneously, so make sure you've chosen the right one, then click "Select 1". Check that the correct ISO and drive are shown on the BalenaEtcher homescreen, then click Flash. Windows will pop up a User Account Control dialog asking whether you want to authorise it to make changes. Allow this, and the process will begin.

3. CONFIGURE YOUR BIOS

Extracting the ISO and writing it to your USB drive should take less than five minutes. Once the process has completed, eject the drive and plug it in to the machine on which you want to install Linux. Start or reboot it, then press the button that either directs it to start from an external drive or opens the BIOS or UEFI. This is usually shown briefly during the boot process. If it isn't, common options are F2, F10, F11 or F12. Search online for your specific motherboard or computer manufacturer if you're not sure which to use on your machine.



Select target 1 found

☑ Name	Size	Location
☑ SanDisk Ultra USB Device	30.8 GB	D:\, E:\

ABOVE Your first step is to download BalenaEtcher.

4. SET YOUR STARTUP DRIVE

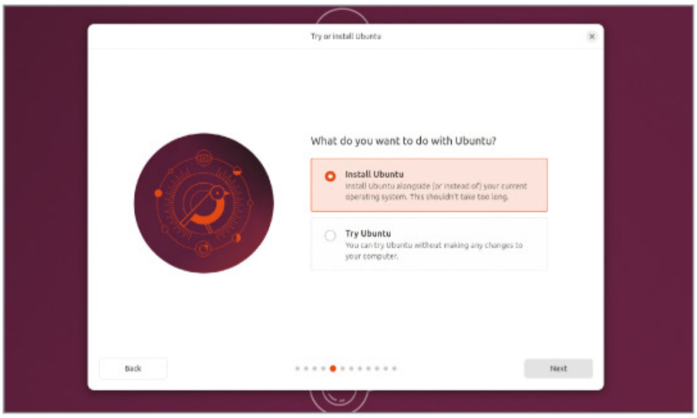
When you've entered the BIOS or UEFI configurator, navigate through its screens until you find an option for setting your boot device. Give priority to your USB-mounted flash drive, save any changes, then exit. Your PC will reboot again. What happens next depends on the build of Linux you're installing. Some will launch a dedicated installer immediately, but many will initiate a live environment in which you can use most of the operating system's features directly. This may be overlaid by a dialog offering to install the OS, or there may be a shortcut to this on the desktop. In either case, initiate the process.

5. INSTALL LINUX

The first few screens of the installation process usually ask you to specify your installation language and keyboard layout. You'll also be asked to set up your network connection if you're not plugged in via Ethernet. You can skip the network step, but we'd recommend following through as it will allow the installer to check whether it can update itself, and to download additional components and options such as third-party codecs that might not be included in the original bundle because they don't have an open-source licence. You will usually be asked whether you want to download these add-ons. We always opt to do so but, depending on how you feel about closed versus open-source code, you'll need to make your own decision.

6. PARTITION YOUR DRIVE

You now need to decide whether you want to install Linux alongside an existing operating system or wipe the drive and install it solo. Either way, make sure you have an up-to-date backup of the original OS from which you can restore should something go wrong when repartitioning the drive. The length of time installation takes can vary significantly, based on the speed of your PC, the speed of your thumb drive, the size of the distro you're installing and whether it needs to download any additional resources. When the process has finished, reboot your PC and, unless prompted to do so earlier, remove the USB flash drive immediately after restart so it's not used as your boot source.

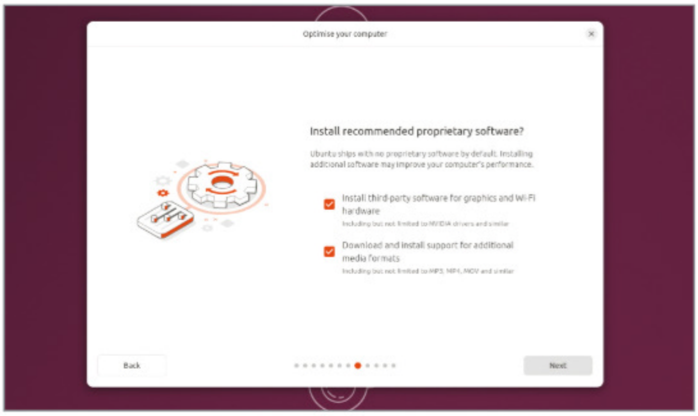


What do you want to do with Ubuntu?

● **Install Ubuntu**
Install Ubuntu alongside (or instead of) your current operating system. This shouldn't take too long.

○ **Try Ubuntu**
You can try Ubuntu without making any changes to your computer.

ABOVE You can choose whether to install Linux or simply try it out.



Install recommended proprietary software?

Ubuntu ships with no proprietary software by default. Installing additional software may improve your computer's performance.

☑ Install third-party software for graphics and Wi-Fi hardware
Including but not limited to NVIDIA drivers and similar

☑ Download and install support for additional media formats
Including but not limited to MP3, MP4, MOV and similar

ABOVE You will usually be asked if you want to install additional software.

Portable distributions

One of the great things about Linux is that you can carry it with you on a USB thumb drive. Here's how.

Linux can run from a USB drive as well as it does from an SSD. You can test most distributions this way before you commit them to internal storage.

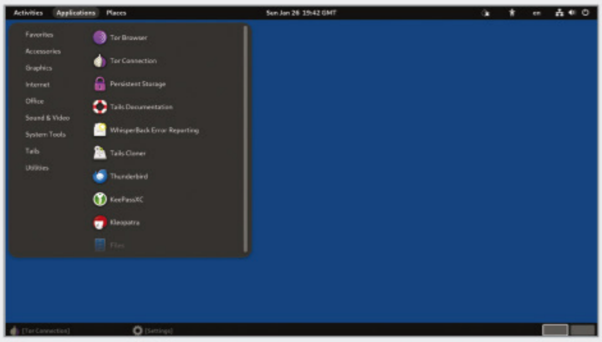
But why stop there? Running an operating system entirely from a USB thumb drive makes it uniquely portable. You can carry it with you if you travel and, so long as you aren't blocked by the host machine's Secure Boot settings, use it to start any device meeting the distribution's minimum spec. Whether that's a friend's old Intel Mac or your Airbnb's ageing PC, you won't risk damaging their setup, nor leaving behind any of your personal data.

Many distributions make a virtue of this.

ABOVE You can run Linux entirely from a USB thumb drive

Head for Tails

The Amnesic Incognito Live System (Tails) is a Debian-based distribution that's designed to live permanently on a USB thumb drive to combat online surveillance and give users a degree of anonymity. It's popular among activists, journalists and anyone who needs to communicate without being observed, such as survivors of domestic violence. It's designed to work on the widest possible range of machines, so provided that your PC is less than ten years old and has a 64-bit processor and 2GB of memory, you should be okay. It works on some Intel Macs, but Apple CPUs and Raspberry Pi aren't supported.

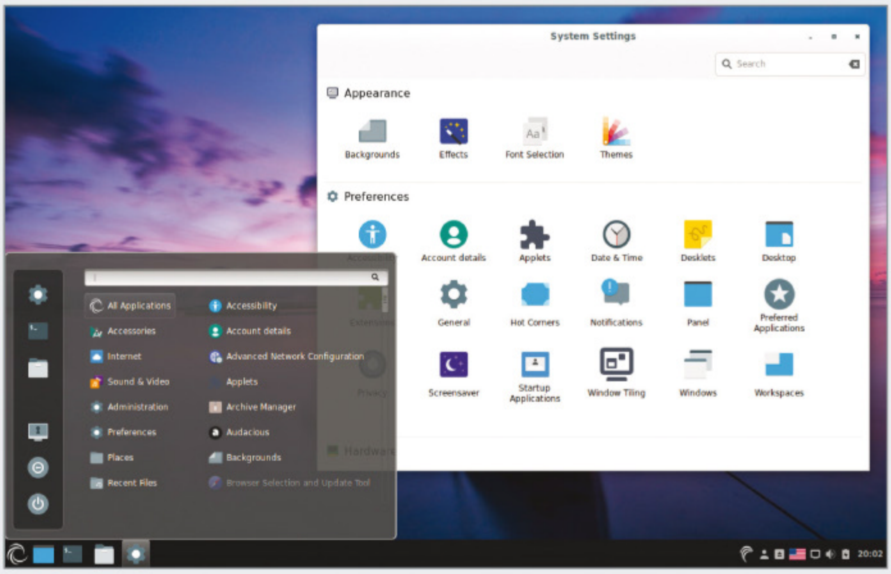

Activities
Applications
Places
Sun Jan 26 19:42 GMT
Favorites
Accessories
Graphics
Internet
Office
Sound & Video
System Tools
Tails
Utilities
Tor Browser
Tor Connection
Persistent Storage
Tails Documentation
WhisperBack Error Reporting
Tails Cloner
Thunderbird
KeePassXC
Kleopatra
Files
[Tor Connection]
[Settings]

RIGHT Tails is designed to protect your identity and to reset every time it's launched.

When you boot Tails, it launches a live system that routes its outgoing traffic through the TOR network. TOR, which was developed in the 1990s by the United States Naval Research Laboratory, bounces data through multiple machines on the way to and from the requested resource, which can help to obscure your identity and location. Once you've finished your work, you shut down the distro in the usual way, at which point everything is reset, so the next time you boot, you're back to square one. In theory, this should keep your data safe, even if you lose the USB stick hosting your Tails environment, but it's not always a convenient way of working.

So, Tails has introduced persistent storage, which lives in a passphrase-protected, encrypted area on the USB stick. If anyone should guess your passphrase, they could decrypt the contents, which is why Tails recommends using between five and seven random words to define it. And, if you don't need to reference the contents of your persistent storage during a particular session, you can simply choose not to unlock it.

Tails is a free download from tails.net and can be installed on an 8GB or larger USB stick, or a recordable DVD.


System Settings
Search
Appearance
Backgrounds
Effects
Font Selection
Themes
Preferences
Account details
Applets
Date & Time
Desklets
Desktop
General
Hot Corners
Notifications
Panel
Preferred Applications
Screensaver
Startup Applications
Window Tiling
Windows
Workspaces
All Applications
Accessories
Internet
Sound & Video
Administration
Preferences
Places
Recent Files
Accessibility
Account details
Advanced Network Configuration
Applets
Archive Manager
Audacious
Backgrounds
Browser Selection and Update Tool
20:02

ABOVE Porteus is a lightweight distro designed specifically to run from a USB drive.

Beyond Tails

Tails isn't the only USB-based distribution. Porteus (porteus.org) is a dedicated portable Linux, as its name might suggest, which needs just 300MB of drive space, so it's the ideal use for a decades-old stick for which you no longer have any use. Just make sure that your stick isn't approaching the end of its usable life. Porteus boots in a matter of seconds, supports 32-bit hardware and is flexible, giving you a choice of seven desktop environments. Unlike Tails, it writes data to the host stick, so changes you make in one session will reappear in the next.

Slax Linux (slax.org), which dubs itself a "pocket operating system", is likewise designed to run from USB full-time. It goes beyond offering different desktop environments, with a choice of underlying distributions: Slackware or Debian. The latter may be more familiar for anyone with experience of Ubuntu and Ubuntu-derived distributions. There are 32- and 64-bit builds, which require just 128MB of RAM to run the desktop, or 512MB if you want to launch the browser.

Of course, it's not all sweetness and light. While portable operating systems have their place, we wouldn't recommend using them on a daily basis if you have any way of instead running a fully installed distribution. Booting from USB often involves interrupting the host machine's regular boot sequence, which can require some quick reactions and BIOS/UEFI tweaking. A USB-based OS is also unlikely to perform as well as one that lives on a hard drive or SSD purely on account of the media on which it lives.

ELEMENTARY OS 8

A good-looking distro designed with security in mind, but we'd be tempted to run with Pop!_OS instead.

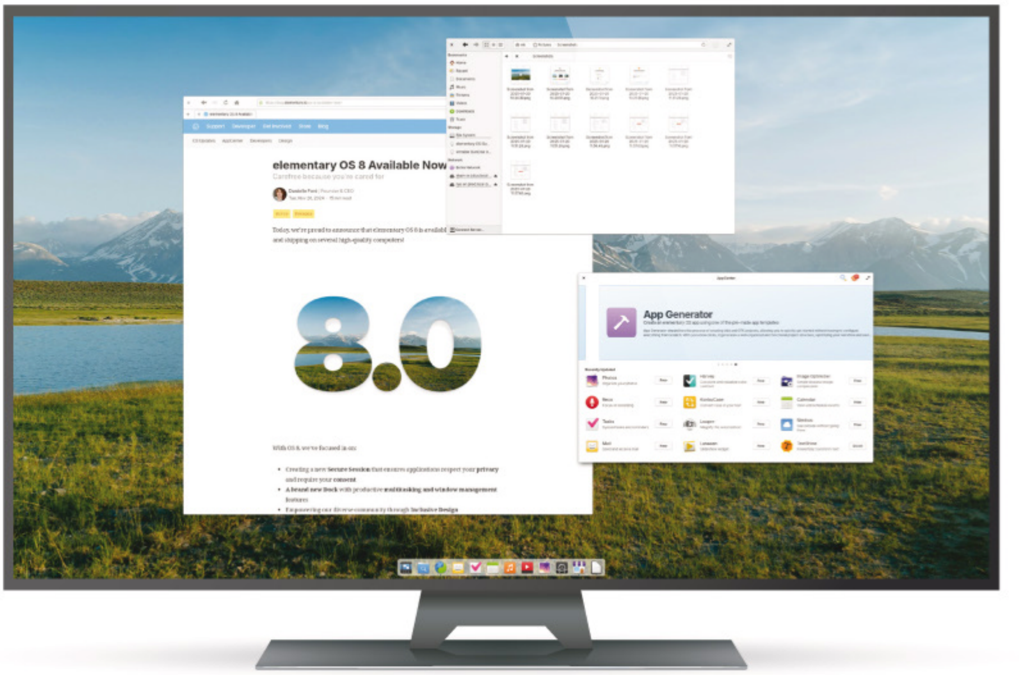
★★★☆☆

WEBSITE elementary.io

64-BIT DUAL CORE
CPU

4GB
MEMORY

32GB
DISK SPACE



ABOVE Elementary uses its own Pantheon interface on the Gala window manager.

Elementary pitches itself as a thoughtful, capable and ethical replacement for Windows and macOS. Currently at version 8, it's based on Ubuntu LTS 24.04.1 and offered on a pay-what-you-can basis (if that's nothing, enter zero in the box on the download page). LTS 24.04 is the most recent long-term Ubuntu release. It shipped in April 2024, which makes it two years younger than the Ubuntu LTS 22.04 on which Pop!_OS is based. It will continue to receive support until August 2029.

Elementary OS looks nothing like Ubuntu, and even if you're familiar with the OS on which it's based, you might need a little time to find your bearings. Installation is quick and easy, with account creation and language selection handled after first boot. At that point, you can also select the colour scheme and optionally set Elementary OS to automatically delete screenshots, downloads, temporary files and the contents of the bin every 30 days – in part to save space, but equally to protect your privacy.

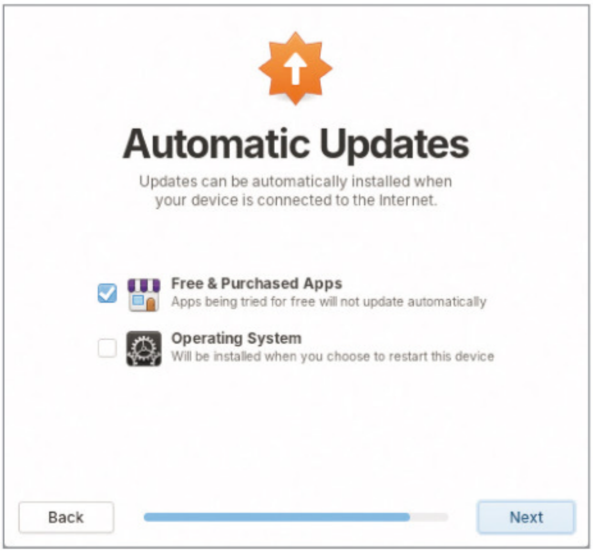
Indeed, Elementary was clearly developed with privacy in mind, and version 8 introduces a significant new feature: Secure Session. You enable this from the login dialog (by clicking the cog before entering your password) and it will use the Wayland display protocol to more tightly control how apps communicate. It also forces applications to labour under additional restrictions over their access to your camera, keystrokes and so on.

The developer claims that the narrow selection of pre-installed apps is "carefully considered", but it's lacking what we would consider some essentials, such as LibreOffice, and desirables such as the GIMP. You can install them from the App Center (which has Flatpak and Flathub support), or from the console, where Elementary OS uses the APT package manager.

The default browser, called Web, identifies as Safari 17, with Pantheon Mail the pre-installed email client. You can install Firefox, Chromium and Thunderbird from the App Center if you prefer. The desktop environment, Pantheon, runs on top of the Gala window manager

There were 103 updates ready for download during our first session. However, you can neatly opt in to automatic updates for free and purchased apps (pre-selected) and the operating system (not pre-checked) as part of the onboarding process. OS updates are applied when you reboot.

Our network hardware was set up as part of the installation process, and our wireless networks were visible on first boot. The five Samba shares running on our local network each showed up in the Files app, allowing us to navigate to them without manually entering hostnames. Our networked printer was likewise detected without us having manually installed any drivers.



Automatic Updates

Updates can be automatically installed when your device is connected to the Internet.

☑ Free & Purchased Apps
Apps being tried for free will not update automatically

☐ Operating System
Will be installed when you choose to restart this device

BELOW It can be set to automatically update your apps and OS during the onboarding process.

Elementary OS is an attractive offering and we welcome its use of the latest LTS release of Ubuntu and its thoughtful assistive technologies

The Settings app includes several handy features, including a screen time and limits section for anyone setting up a PC for kids (or for personal use if you need to impose some self-discipline). Further, while our monitor was correctly identified, the controls went beyond simple resolution and scaling settings seen elsewhere to offer colour deficiency assistance. This adjusts the entire colour palette to correct for protanopia, tritanopia and other tone-related issues, making this a sensible choice for anyone affected.

You can also set the display to greyscale to help with colour blindness. We found this mode relaxing for general use, but be aware that the effect is applied across the entire UI, including any images displayed on web pages and colour in documents, rather than just to interface elements. For more serious visual impairments, the operating system's built-in screen reader is easily accessed from the corner menu, where you can also invoke dark mode and the onscreen keyboard.

Elementary OS is an attractive offering and we welcome both its use of the latest LTS release of Ubuntu and its thoughtful assistive technologies. However, we didn't feel entirely at home the way we did in other distros, such as Fedora and Ubuntu – and, if we were looking for something significantly different to the "norm", we'd more likely opt for Pop!_OS.

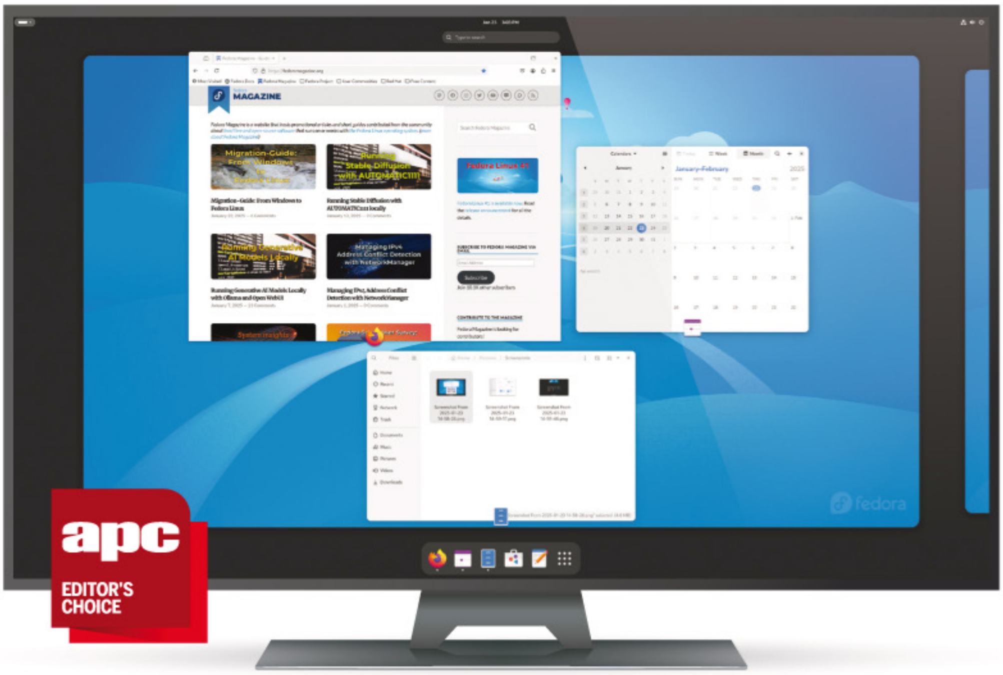
FEDORA WORKSTATION 41

This Red Hat-sponsored distribution is now over 20 years old, making it a rock solid choice.

★★★★★

WEBSITE fedoraproject.org

NOT STATED	4GB	40GB
CPU	MEMORY	DISK SPACE



ABOVE Fedora's implementation of Gnome is clean and attractive.

Fedora celebrated its 20th birthday in 2023, which makes it one of the longest-established distros on test. It has an impressive heritage, with roots in the Red Hat Linux project. The association continues to the present day, with Red Hat employees contributing to Fedora's development, Red Hat itself sponsoring Fedora, and – in a virtuous circle – innovations rolled out in Fedora feeding back into Red Hat Enterprise Linux. If you use Red Hat in a business environment, it therefore makes a lot of sense to opt for Fedora at home.

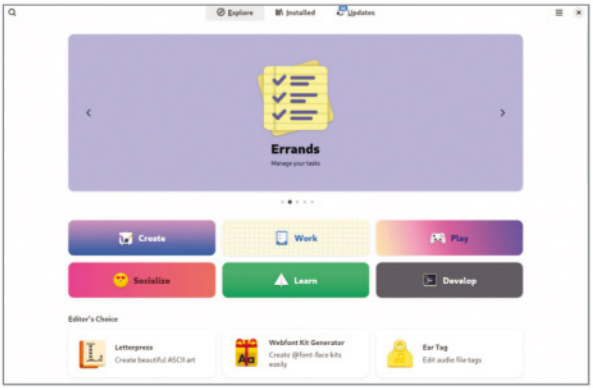
A new build is released roughly every six months and supported for 13 months, so this is a distro that refreshes regularly but doesn't require an update (patches aside) more than once a year if you're looking for stability. It uses the 6.11 Linux kernel. At the time of writing the latest stable release is 6.12.10.

You can download the ISO directly for Intel and AMD x86_64 systems, Arm aarch64 devices and Power ppc46le systems, but we'd recommend using the Fedora Media Writer. Stick with the default options and this will walk you through the process of downloading the latest build and writing it to a bootable USB stick. Eject it when it's finished, boot your target machine, then use the graphical Anaconda installer. This is the same installer as used by CentOS, Rocky Linux and Red Hat, and is logical and well thought through. You'll set up your user account and location on first boot.

As with each of the distros on test, we set up Fedora Workstation with Ethernet connected so it could get online and download any additional packages it required. Wi-Fi was ready to use on first boot, and our network printer was detected without us manually installing any drivers. The five Samba shares running on our network were also detected and advertised in the Files app, so we could access them without manually entering their local addresses.

Fedora Workstation 41 runs the Gnome 47 desktop environment on Wayland. A welcome move, as Wayland is increasingly replacing X11, with the promise of greater efficiency, flexibility and security. Gnome, meanwhile, is attractive, logical and again flexible – and the Adwaita icons and cursor pack employed here are clean and smart. The default system font is Cantarell, which gives this build a lighter feel than some Gnome-based implementations. You can pin your most used apps to a Dock, macOS style, to which Windows switchers should have no trouble adapting, and you'll probably want to install Gnome Tweaks so you can enable maximise and minimise controls on your app windows. Overall, it's a pleasant, calming and attractive environment in which to spend your working day.

If you don't like Gnome, you can install a range of alternative desktops, including KDE Plasma, Cinnamon (as used by Mint), Mate and Xfce (as used by MX Linux). To do so, select Spins in the Media Writer when asked which release you want to install, and pick your option from the drop-down menu.



BELOW Anything else you need can be downloaded from the installer.

LibreOffice Writer, Calc and Impress are installed by default, so you'll be productive from day one. The default browser is Firefox but there's no pre-installed email client (as there hasn't been for several years). There are several utilities, including a document scanner, maps, the Rhythmbox media player and Boxes virtualisation environment; anything else you need is easily installed from the graphical Software app or at the terminal prompt. The Fedora software repository is enabled by default, alongside Flathub. There were 31 system and software updates waiting for download when we first logged on.

There's much to like about Fedora. It has heavyweight backing, a significant user base, and a long heritage

Since 2015, the default package manager, which you'll encounter if you install at the command line, has been DNF (Dandified YUM). This works in much the same way as APT (Advanced Package Tool) on Debian-based systems. While their commands may differ, their functions are analogous, and there's no reason to select one distribution or another on this basis.

There's much to like about Fedora. It has heavyweight backing, a significant user base and a long heritage. It's regularly updated and well supported, and its strong link to Red Hat Enterprise Linux makes it an excellent choice for home users who also use Linux in the workplace. Although it came behind the other distributions in the Geekbench tests, you would never guess that when using it, which is why we're putting very little weight on the raw speed data in our overall judgement.

LINUX MINT 22.1

This is a popular choice for Windows switchers for good reason, but don't ignore the alternatives.

★★★★☆

WEBSITE linuxmint.com

NOT STATED CPU
4GB MEMORY
100GB DISK SPACE

Sublime
linuxmint
New Features
Linux Mint 22.1
apc
HIGHLY RECOMMENDED

ABOVE With a taskbar and categorised app menu, Linux Mint will feel familiar to Windows switchers.

Linux Mint is one of the most talked-about distributions, for reasons we'll come to later. Ubuntu-based, it's been around for 18 years and has earned itself a loyal following. It's updated roughly one month after the Ubuntu LTS build on which each version is based, so you should see a major release every other year, along with point releases every six months. Major builds are supported for five years, with support for this release, codenamed Xia and based on Ubuntu 24.04 LTS, running through to 2029.

The installation process is the same as for Ubuntu: as it handles creating your user account, all you need to do once it's finished is log in. At this point you'll encounter the well-designed onboarding process, presenting a series of one-click buttons to change the system colours, open Settings, set up system snapshots and so on. The snapshots option is particularly welcome as it establishes regular periodic saves of essential system data from the outset. The process uses Cron in the background and, by default, makes a daily backup that's kept for five days.

As with the other distributions on test, we installed Linux Mint when connected to Ethernet so that it could download any additional components it required. Upon first boot, it detected our Wi-Fi hardware and we could connect directly to our wireless networks. It had spotted our networked printer without us manually loading any drivers, and the Files app exposed each of the five Samba shares running on our local network.

Mint uses its own desktop environment, called Cinnamon, which runs on X11 (Wayland is an option). Initially, there are three themes to choose from – Minty-L, Minty-X and Minty-Y – and you can opt for Mixed, Dark or Light appearances in a spectrum of colours. However, step into the advanced theme settings and you'll find a range of alternative options, including Yaru, which will be familiar from several other distributions.

Linux Mint is often named as the ideal distribution for Windows switchers, and we can see why that's the case, with its familiar taskbar, the lack of a top menu bar and a launcher with a split listing that's highly reminiscent of the Windows Vista and 7 Start menus. Typing when the menu is visible filters matching apps on the fly: a behaviour that also manifests in KDE and Gnome environments.

However, before immediately opting for Linux Mint, we'd recommend also checking out Zorin OS (**zorin.com**). The default theme in the free edition is likewise highly Windows-esque, and if you opt for the paid Zorin Pro ($48), you can choose between Windows Classic, Windows 11, ChromeOS and macOS themes. We haven't reviewed Zorin OS in this Labs as it hasn't changed a lot since our last review, but it remains a strong choice.

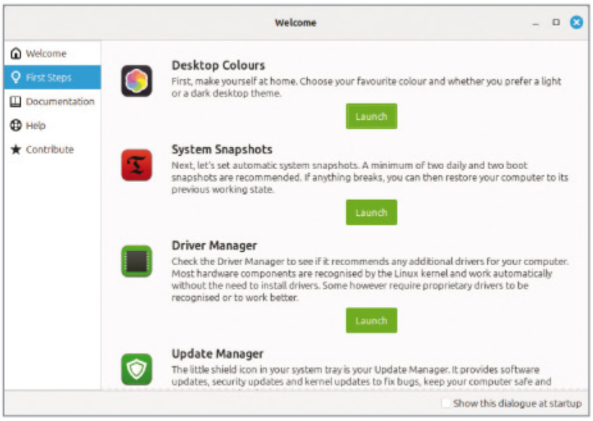
If you don't like Cinnamon, Mint is also available with Mate and Xfce desktop environments, which you'll find if you pick "All Versions" from the Downloads drop-down menu at **linuxmint.com**.

The default install bundles a range of useful apps, including LibreOffice, Rhythmbox and Hypnotix. The last of these is a neat IPTV streaming app that gives access to free channels from 94 countries. Even if you're not interested in international sports or entertainment, it's a valuable resource for language learning.

If you want to get up and running quickly, you could do far worse than choose Linux Mint. It comes with everything you need

The default browser is Firefox, and Thunderbird is pre-installed to handle email. You can install anything that isn't present at launch – such as GIMP – using the bundled Software Manager or by typing at the command prompt.

If you want to get up and running quickly, you could do far worse than choose Linux Mint. It's fully featured and comes with everything you need. The fact that Hypnotix is thrown in makes it a tempting proposition for anyone who likes to keep half an eye on the telly while working. The launch menu is highly reminiscent of older versions of Windows, so this would certainly be an apt next step for anyone upgrading an outdated PC running XP or Vista, but it's not the only OS that offers this. Manjaro and MX Linux, for example, have similarly reminiscent menus, and we'd also suggest taking a look at Pop!_OS, which will handsomely repay a few minutes getting to grips with its super-fast UI.



Desktop Colours
First, make yourself at home. Choose your favourite colour and whether you prefer a light or a dark desktop theme.

System Snapshots
Next, let's set automatic system snapshots. A minimum of two daily and two boot snapshots are recommended. If anything breaks, you can then restore your computer to its previous working state.

Driver Manager
Check the Driver Manager to see if it recommends any additional drivers for your computer. Most hardware components are recognised by the Linux kernel and work automatically without the need to install drivers. Some however require proprietary drivers to be recognised or to work better.

Update Manager
The little shield icon in your system tray is your Update Manager. It provides software updates, security updates and kernel updates to fix bugs, keep your computer safe and

☐ Show this dialogue at startup

BELOW You can set up system snapshots to secure your data from day one.

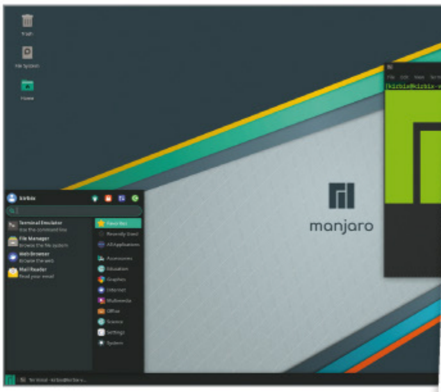
Moving from Windows: what you need to know

Whether you're looking for an upgrade from Windows 10, a second operating system or are simply interested in Linux, here's some handy advice.

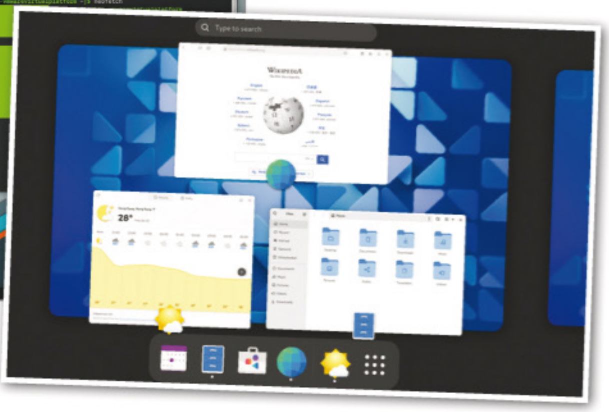
Caveat emptor, the Romans said: buyer beware. The phrase may be two millennia old, but the buyer's obligation to apply due diligence before making a purchase – whether it be of a second-hand car or a new house – still applies today.

It's also true when choosing a new operating system. Whichever you settle for, you'll spend hours using it, perhaps for the next few years. You'll expect it to work flawlessly when managing your data, and probably trust it with irreplaceable personal files, such as emails and photos. It's fortunate, then, that in almost every case, you can try before you buy.

Each of the distributions on test is free to download, install and use for as long as you like. In most cases, you don't even need to go that far, as the installers themselves live within a live edition of each OS, which you can boot from a USB thumb drive and thoroughly test before committing it to your hard drive or SSD. For a longer-term test, consider installing one as a virtual machine. That way you can run it inside Windows without making any fundamental changes to your configuration.



ABOVE Manjaro will be familiar to anyone switching from an old version of Windows.



ABOVE RIGHT In Gnome, apps are often arranged in a grid, like on a smartphone.

Kicking the tyres

Get a feel for the operating system. You'll probably spend most of your time interacting with the GUI, so start there. By far the most common options are Gnome and KDE, with the latter often being the most Windows-like thanks to a pop-up application menu. In Gnome, apps are more often arranged in a grid, as they are on a smartphone, or in macOS's Launchpad, unless you've added a drop-down Applications menu to the top menu bar.

But while familiarity can be comforting, we'd countenance against making it your only criteria – or even, perhaps, your primary consideration. It takes very little time to get used to a new operating system, and with KDE and Gnome both having comprehensive in-build search tools, you can quickly find an app or setting by pressing the super key (the Windows key on most keyboards) and typing a few characters. Pretty soon, you'll stop noticing either the similarity to or difference from Windows, and start navigating the UI on its own terms.

More fundamental differences between Windows and Linux (and less so between macOS and Linux) appear when you scratch the surface. You'll soon come to realise that many small jobs can be done more quickly using typed commands, some of which may be similar to Windows equivalents, but many of which are significantly different – not just between Windows and Linux, but between different Linux distros.

While familiarity can be comforting, we'd countenance against making it your only criteria – or even your primary consideration

Mimics need not apply

Here, then, we wouldn't recommend looking for something that mimics what you already know from another platform, but rather to consider where else you might come across Linux, and to choose a distribution from the same family. If your web host uses Debian, for example, choose something like Ubuntu or Mint. If work uses Red Hat Enterprise Linux, check out Fedora. That way, whatever you learn in one environment will apply equally to another.

If you're unlikely to encounter Linux anywhere but on your own machine, this advice clearly doesn't apply, but knowing which family your distribution belongs to can still be worthwhile. More distros have roots in Debian than anywhere else, so familiarising yourself with Debian-based commands gives you the best chance of using them elsewhere in the future. The Red Hat/Fedora group comes second and Arch a close third.

BELOW More distros have roots in Debian than anywhere else.

The support question

Finally, consider security and support. Linux is pretty robust against malware, but you still want to be running an updated and fully patched operating system. So, check how active the developer community is, how often the distribution is patched, when cutting-edge or long-term builds are released, and for how long each receives support.

Naturally, this final consideration – support – will also be influenced by the environment in which you're installing and using Linux. If you're a home user, much of your ongoing support will be self-guided and involve reading manuals, tinkering, and turning to forums.

That's not always acceptable in a business context. There, consider how you can ensure continuity of service in business-critical systems, even if this means contracting the job to a third-party. If you take this route, be guided by them in your choice of distribution. After all, you want to know that they understand the system inside out.

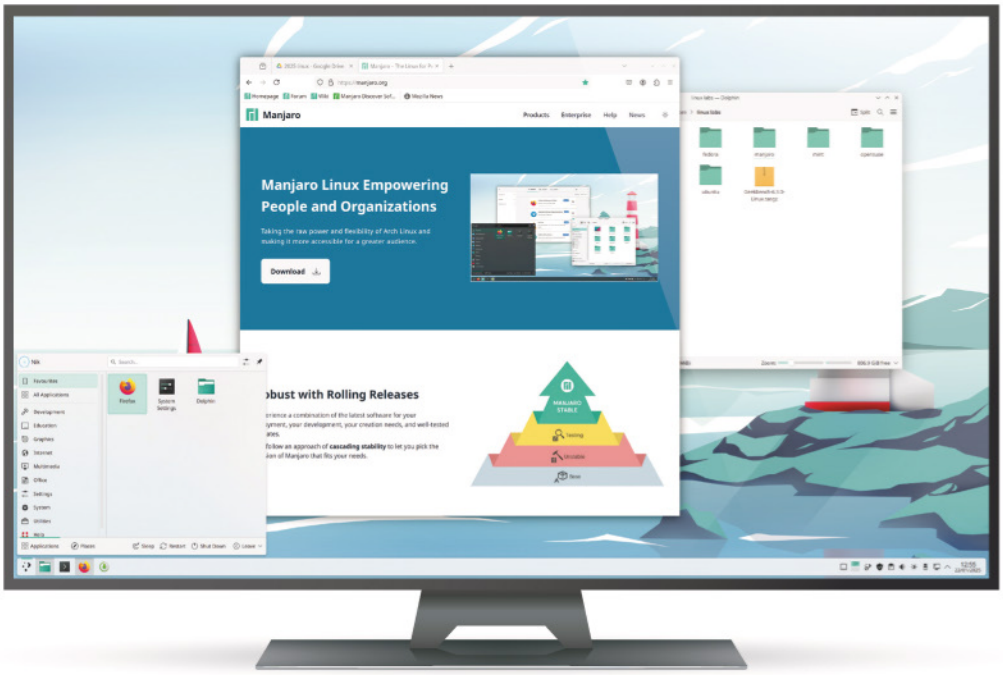
MANJARO

Rolling updates mean it will stay current, but while a solid choice for Windows escapees it needs tweaking.

★★★☆☆

WEBSITE manjaro.org

DUAL CORE **CPU** · **4GB** **MEMORY** · **30GB** **DISK SPACE**


Manjaro
Manjaro Linux Empowering People and Organizations
Taking the raw power and flexibility of Arch Linux and making it more accessible for a greater audience.
Download
bust with Rolling Releases

ABOVE **The default interface should pose no problems for Windows switchers.**

Manjaro is the only Arch-based distro on test. Along with the Arm variant, for phones, there's the x86 variant – and naturally that's the one we tested. The distro is available with a choice of desktops: KDE Plasma, Xfce and Gnome as official images, supplemented by community images featuring Cinnamon (as seen in Linux Mint), i3 and Sway WM. We opted for KDE Plasma as it was presented first in the list of official images. Our build, available in Minimal and Full flavours, was released on 16 December last year.

Manjaro uses a rolling release model in which the core is continually upgraded as replacement builds become available. That means you shouldn't need to do a large manual update at any point. As such, there's not really a version number, and if you enter "cat /etc/os-release" at the terminal, you'll see that BUILD_ID = rolling. Technically, therefore, so long as you keep applying patches when they're released, you'll never reach the end of your operating system's support window.

As with KDE in openSUSE and Cinnamon in Linux Mint, this distro should be familiar to anyone switching from an older version of Windows, thanks to a screen-wide taskbar and categorised app menu. Open the menu and start typing, and the list of matching apps and options is streamlined in real-time. Helpfully, the results include settings as well as software, so if you're looking to change your resolution you only need to get as far as "reso" for Display Configuration to be the top hit. This makes navigating the operating system extremely easy, which should soften the landing for less experienced users.

By default, KDE on Manjaro runs on the X11 windowing system, but you can switch to Wayland from the login screen (and switch back and forth like this as often as you require). As was the case with KDE on openSUSE, we found the Wayland implementation to be brighter and bolder at its default settings, but you can tweak X11 for similar results.

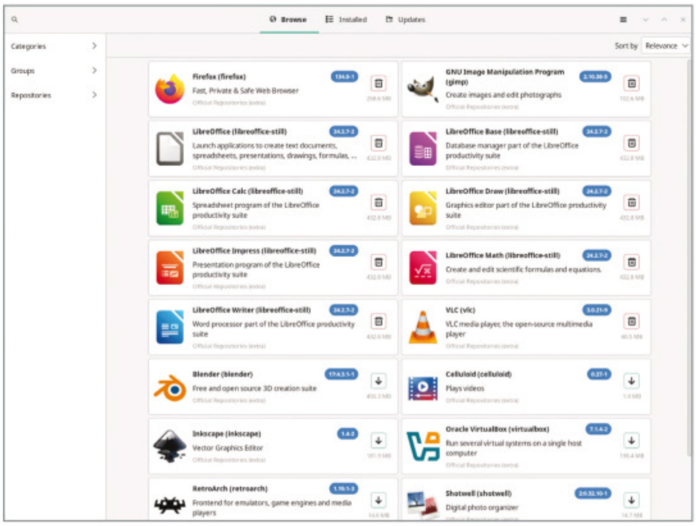
Setup is simple. It's managed by the Calamares installer, which walks you through the process of choosing your language, location and so on, and also lets you choose between two office suites or no office suite at all. Your options are LibreOffice, as seen in most other suites, and SoftMaker FreeOffice. Like LibreOffice, FreeOffice is also available for Windows and it can read and edit Microsoft Office files. It's a good-looking suite with a colourful ribbon interface, but to access high-quality dictionaries for spellchecking, table styles, footnotes and endnotes, picture captions and several other features, you'll need to upgrade to the charged-for SoftMaker Office. You can see the full comparison table at **tinyurl.com/APC546softmaker**.

Elsewhere, you'll find a healthy selection of utilities, including the Elisa music player and VLC. GIMP and Inkscape, while available through the bundled app store, weren't installed by default, but this isn't unusual. The pre-installed web browser is Firefox, but there's no email client. Kmail, Thunderbird and other options are again available through the installer.

Technically, so long as you apply patches when they're released, you'll never reach the end of your operating system's support window

There were eight packages ready for an update on first boot, once our wireless networking hardware had been detected and set up. As with openSUSE, our networked printer and the five Samba shares on our local network weren't immediately accessible, although when we manually added our printer using its IP address, the correct manufacturer was detected. We could also access our Samba shares using their IP addresses, but using local hostnames failed in our default configuration.

Manjaro with KDE Plasma is attractive, and if you're looking for a familiar non-Microsoft upgrade path from an older version of Windows, this would be one to shortlist alongside Mint, openSUSE and Elementary OS – or, indeed, any KDE-based distro. Although we encountered a few niggles on our test platform, they're the kind of things that, once overcome, won't be an ongoing issue.



Firefox (firefox) – Fast, Private & Safe Web Browser
GNU Image Manipulation Program (gimp) – Create images and edit photographs
LibreOffice (libreoffice-still) – Launch applications to create text documents, spreadsheets, presentations, drawings, formulas, ...
LibreOffice Base (libreoffice-still) – Database manager part of the LibreOffice productivity suite
LibreOffice Calc (libreoffice-still) – Spreadsheet program of the LibreOffice productivity suite
LibreOffice Draw (libreoffice-still) – Graphics editor part of the LibreOffice productivity suite
LibreOffice Impress (libreoffice-still) – Presentation program of the LibreOffice productivity suite
LibreOffice Math (libreoffice-still) – Create and edit scientific formulas and equations.
LibreOffice Writer (libreoffice-still) – Word processor part of the LibreOffice productivity suite
VLC (vlc) – VLC media player, the open-source multimedia player
Blender (blender) – Free and open source 3D creation suite
Celluloid (celluloid) – Plays videos
Inkscape (inkscape) – Vector Graphics Editor
Oracle VirtualBox (virtualbox) – Run several virtual systems on a single host computer
RetroArch (retroarch) – Frontend for emulators, game engines and media players
Shotwell (shotwell) – Digital photo organizer

BELOW **The integrated installer is stacked with all the software you're likely to need.**

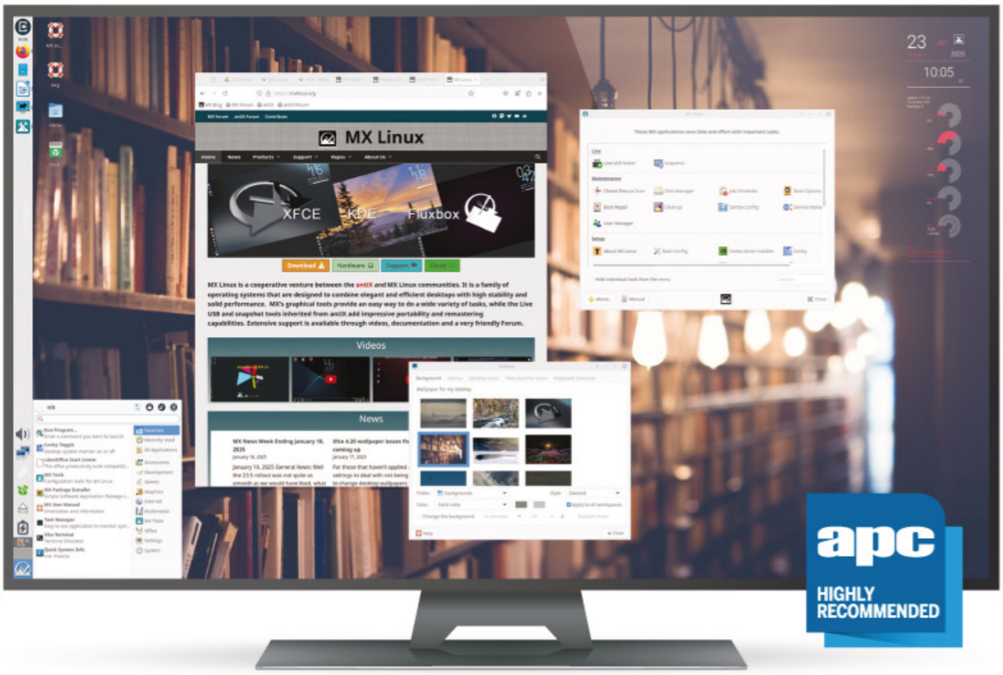
MX LINUX 23.5

This lightweight distro is a great choice for squeezing life out of older PCs, but it's not the slickest option.

★★★★☆

WEBSITE mxlinux.org

i686 OR LATER	2GB	20GB
CPU	MEMORY	DISK SPACE



ABOVE This is the only distro on test in which Xfce is the default desktop environment.

This is the only distribution on test running the Xfce desktop environment by default. Designed to run well on less powerful hardware, this makes MX Linux a natural choice for anyone who wants to squeeze a few more years of life out of an ageing machine. If you don't get on with Xfce, it's also available with KDE and Fluxbox, but there's no harm in giving it a go: you can install alternatives later, including Mate, Gnome Base and Budgie, from the Package Installer.

In its default state, this particular implementation of Xfce looks more basic (and to our eyes less appealing) than KDE or Gnome, but it's highly customisable and you can add themes, so there's no reason for it to stay like that. For example, the panel, which runs up the left border and gives quick access to your preferred apps, was small on our 32in display, but right-clicking it gave us direct access to its settings. Here, we adjusted the row size to a more comfortable 60 pixels and changed the colour, but you can add and remove items, and more besides.

We went on to entirely swap out mx-comfort, which is the distro's default theme, opting for Arc for applications and the Window manager, and Adwaita for icons and cursors. This was a quick and easy fix that brightened things up enormously and created a far more appealing environment in which to do our work.

Whatever change you want to make, anywhere in the system, you should have little trouble finding the dialog to implement it: simply press the Windows (or, on Macs, the symbol) key and start typing the first few characters of the most logical shortcut. For example, if you need to change the overall resolution, type "di" or "resol" (for display or resolution) and before you go any further, the Display settings will be pre-selected. This kind of navigation, which we've highlighted elsewhere, is a boon for new users who are finding their feet in unfamiliar territory.

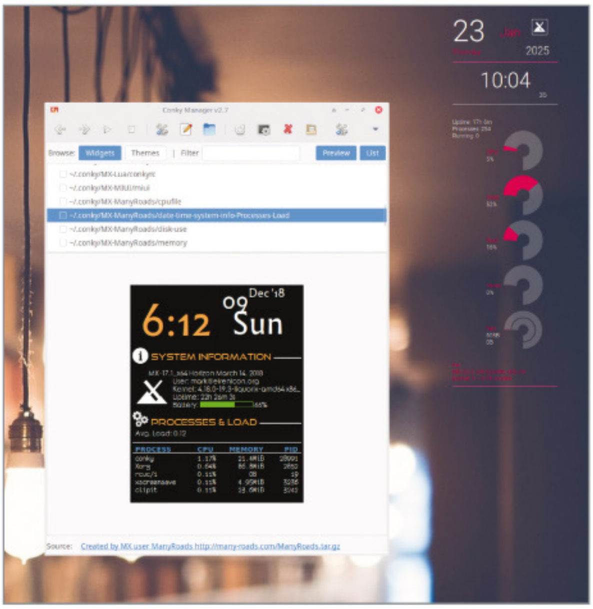
Those same users may likewise welcome the traditional categorised applications menu, which will be familiar to anyone switching from older versions of Windows.

On first boot, MX Linux detected our wireless hardware and we could see our Wi-Fi networks. Our networked printer had also been spotted without us installing any third-party drivers, and when browsing the network through Thunar, the file manager, we could see our Samba shares.

Firefox, Thunderbird and VLC come pre-installed, along with a range of media players, utilities and a handful of brain-improving games – but no GIMP or Inkscape. These, along with hundreds of other apps, are available through the Package Installer, which may lack the visual appeal of app stores seen elsewhere but is searchable and logically categorised.

Conky, which is an optional add-on for other distributions, is also pre-installed. If you like to keep an eye on your resources and how they're being used, you'll love it, as its integrated widgets let you display a wide range of live data directly on the desktop. Or you could just use it to show a pretty clock.

MX Linux is a highly configurable and fun distribution, with extremely conservative system requirements



BELOW Dip into Conky and you can display all sorts of interesting data on the desktop.

Overall, MX Linux is a highly configurable and fun distribution, with extremely conservative system requirements. Version 23.5, on test here, will run on an i686 Intel or AMD processor with 1GB of memory and 6GB of storage. That's impressive, and even the "recommended" specs are far from demanding, stretching to 2GB of RAM and 20GB of drive space. As it will run on 32-bit hardware, there's no excuse to throw out an old machine when you could repurpose it for background tasks, network storage or even daily use. This build is supported until June 2028.

Perhaps unsurprisingly, given these requirements, it was the fastest distribution by a comfortable margin on our test machine. In single-core and multicore runs in Geekbench, it beat the slowest distribution by 11% and 28% respectively. However, as we noted in our Fedora review, each of the distributions on test felt slick in general use, so we're not putting much weight on raw performance in our scores.

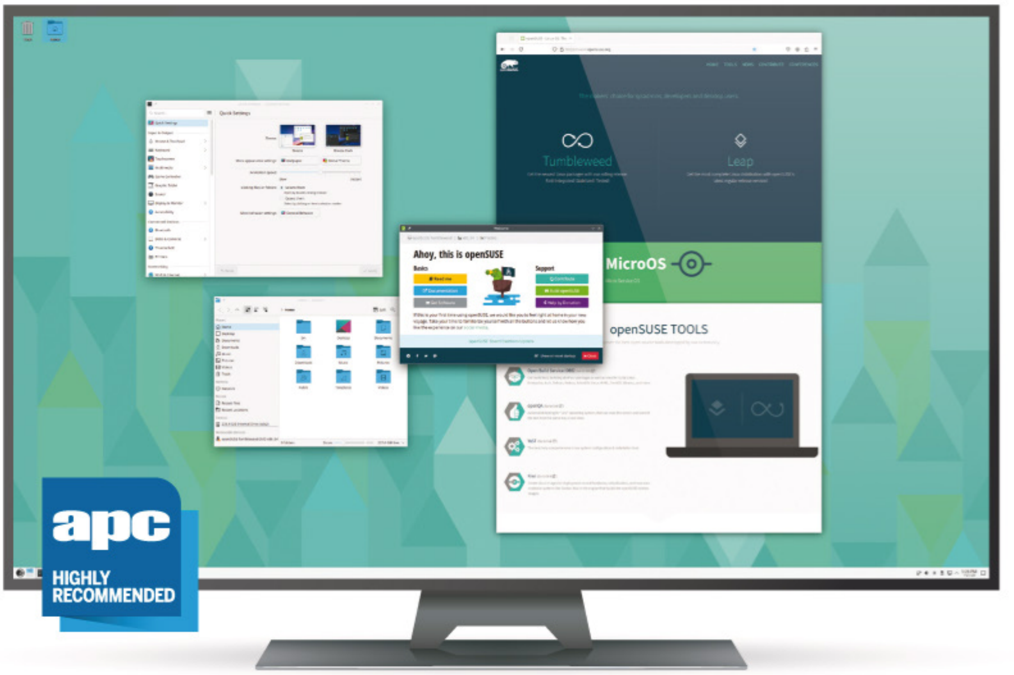
OPENSUSE TUMBLEWEED 20250120

Windows 10 EOLers should definitely give Tumbleweed a try, with a familiar interface and constant updates.

★★★★☆

WEBSITE get.opensuse.org

2GHz DUAL CORE CPU | **2GB** MEMORY | **40GB** DISK SPACE



apc HIGHLY RECOMMENDED

ABOVE The default desktop environment in openSUSE is KDE Plasma 6.

Now 30 years old, openSUSE is one of the longest-standing distributions still in widespread use. Despite this, it will almost certainly be the most up-to-date option whenever you choose to install it. That's because Tumbleweed is in continuous development, with a new release shipped every day. Indeed, look at the official title of this review and you can work out when we downloaded it (naturally, there were no patches available for installation upon first boot).

If you don't like the idea of an ever-changing distribution, opt instead for openSUSE Leap. This is a more traditional model with major updates appearing annually and an emphasis on stability rather than including the most cutting-edge components. You'll need to invoke it manually to upgrade a Leap installation, but with Tumbleweed the process is more frequent, with updates appearing as soon as they've been integrated and tested by the openSUSE community. As such, there isn't a traditional support period for Tumbleweed releases the way there is for a conventional operating system.

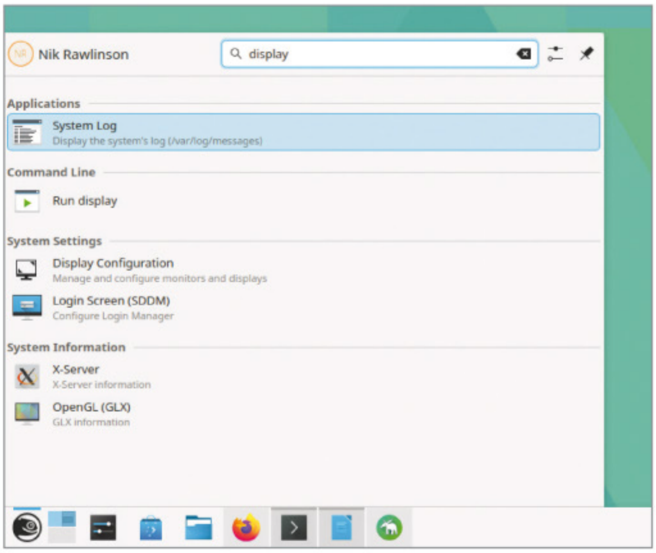
The installer presented no surprises. Everything was well explained and logical, and it handled user account creation as part of the process. On our PC's restart, it had detected our wireless hardware, but not our networked printer. The five SMB servers on our local network didn't appear in the Dolphin file browser, either. It turned out that access to both the servers and the printer were being blocked by the firewall. Fortunately, there was an easy fix: using the integrated Firewall configuration tool to add the necessary services to the Allow list.

The preferred user interface is KDE Plasma 6 (which we're using here), although the installer also gives you the choice of Gnome, Xfce and IceWM. Elsewhere, you'll find downloads for Cinnamon (as used by Linux Mint), Mate, Pantheon (as used by Elementary OS) and others.

The first time we logged in, it used the X11 window manager, which many distributions are swapping out in favour of Wayland. You can switch to Wayland on the login screen, and when we did this we found that the UI was both brighter and much larger, as the zoom had been reset to 150%, which we found more comfortable for ongoing use. You can naturally change this to whatever you prefer in both Wayland and X11.

Windows switchers are frequently encouraged to opt for Linux Mint if moving to open source, but we'd argue that openSUSE is just as easy to get to grips with, thanks to the familiar taskbar and a categorised application menu. Open the menu and start typing the name of the app or feature you're after, and the list of results will be filtered on the fly. The fact that the results include settings makes finding your way around Tumbleweed easy.

> There are plenty of reasons to recommend openSUSE Tumbleweed, and really only one thing that counts against it



BELOW If you're looking for a setting or an app, just open the menu and start typing.

Our installation featured a full range of familiar applications, including Firefox for browsing, Kmail for comms and LibreOffice. Neither GIMP nor Inkscape were preinstalled, but they're available through the Discover installer, which provides access to repositories such as Flathub, Flatpak, openSUSE and KDE Store. Elsewhere, there's a generous selection of utilities, a handful of brain-improving games and VLC, which cover everything you need to get started.

If you pride yourself on running the latest possible build of your operating system, then look this way. The same goes if you want the option to switch between X11 and Wayland, and an almost unbeatable range of desktop environments. Windows switchers – and particularly those moving up from an older release with a more traditional start menu – would likewise do well to consider this alongside Linux Mint.

So, there are plenty of reasons to recommend openSUSE Tumbleweed, and really only one thing that counts against it: the additional tinkering we had to do post-install to get it working the way we wanted. Fortunately, that's the kind of thing you should need to fix only once.

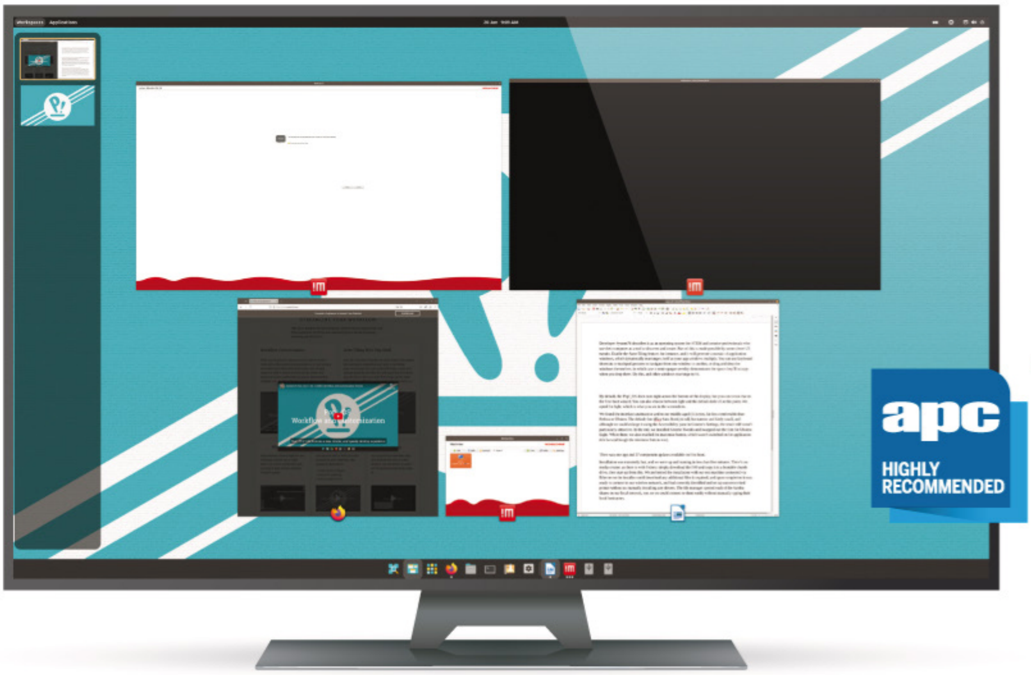
POP!_OS

A great choice for advanced users who love keyboard shortcuts and it runs quickly on older PCs too.

★★★★☆

WEBSITE pop.system76.com

64-BIT CPU | **4GB** MEMORY | **16GB** DISK SPACE



ABOVE Neat innovations help you navigate and arrange your windows quickly.

Developer System76 describes Pop!_OS as an operating system for STEM and creative professionals who use their computer as a tool to discover and create. In part, this is made possible by some clever UI tweaks that help you navigate the interface more quickly. Enable the Auto-Tiling feature, for instance, and it will generate a mosaic of application windows, which dynamically rearranges as your windows multiply. You can use keyboard shortcuts or trackpad gestures to navigate from one window to another, or drag and drop the windows themselves – in which case a semi-opaque overlay demonstrates the space they'll occupy when you release them. When you do this, other windows rearrange to fit.

The way you find and launch apps has been rethought, too. Press the Windows/symbol key and, rather than shrinking the workspace to show a grid of apps, it opens the Pop!_OS launcher. This doesn't feature a grid of apps, as you may have encountered elsewhere, nor a two-column menu as you might see in KDE- or Cinnamon-based distros. Instead, applications have been organised by type-based folders, with categories for Office, System and Utilities. You can add your own categories as you install further apps. Type the first few letters of the app you want to use and the list is filtered in real-time until you find what you need. It's extremely responsive, with no lag at all on our almost six-year-old test machine. Indeed, we were impressed by the speed at which Pop!_OS performed throughout our tests and would have no hesitation in using it to extend the working life of an old device.

The only thing that might initially discourage us is the default interface, which, to our 50-something eyes, is less comfortable and attractive than Fedora or Ubuntu. The default font (Fira Sans Book) is tall but narrow and fairly small, and although we could enlarge it using the Accessibility pane in Gnome's Settings, we eventually installed Gnome Tweaks and swapped out the font for Ubuntu Light. While there, we also enabled the maximise button, which, unlike the minimise button, wasn't switched on for application title bars.

By default, the Pop!_OS panel (or taskbar) runs right across the bottom of the display, but you can tweak that in the first-boot wizard. You can also choose between light and the default dark UI at this point. We opted for light, which is what you see in the screenshots.

Installation was extremely fast, and we were up and running in less than five minutes. There's no media creator as there is with Fedora: simply download the ISO and write it to a bootable thumb drive, then start up from this. We performed the installation with our test machine connected via Ethernet so the installer could download any additional files it required.

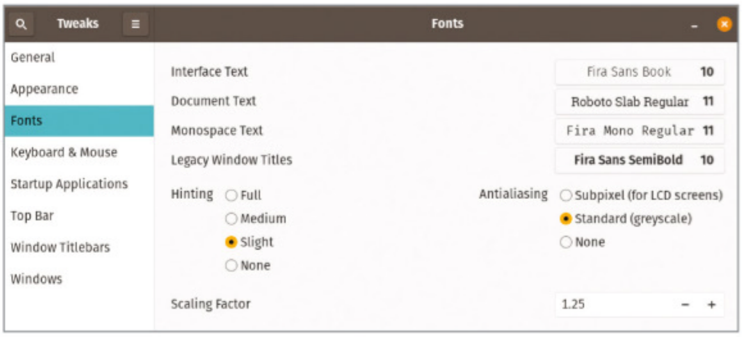
Upon completion it was ready to connect to our wireless network and had correctly identified our networked printer without us manually installing any drivers. The file manager spotted each of the Samba shares on our local network, too, so we could connect to them easily without manually typing their local hostnames. Firefox is the default browser, while Geary sits ready to handle email. There was one app and 37 component updates ready to download upon first boot.

Pop!_OS is Ubuntu-based, with this release drawing code on the 22.04 LTS build (released in April 2022, and supported until April 2027). At present it runs Gnome 42 on X11, although System76 is working on Cosmic, a new desktop environment that looks set to roll the best of Pop!_OS's workflow management tools into a full-on Gnome replacement. To find out more, visit **system76.com/cosmic**.

It's extremely fast – you feel like you're flying from one task to another – and we were quickly won over by the re-thought launcher

Although we initially found Pop!_OS a little unattractive, we quickly grew to enjoy it, and anyone who writes it off too soon will be doing themselves a disservice: if you don't get on with the look and feel, tweak them. Anecdotally, it's extremely fast – you really do feel like you're flying from one task to another – and we were quickly won over by the re-thought launcher. It kept our ageing machine feeling sprightly, and on that basis alone the time it takes you to set it up could be the most profitable few minutes you spend today.

BELOW We made a few changes to the default appearance using Gnome Tweaks.



Interface Text: Fira Sans Book 10
Document Text: Roboto Slab Regular 11
Monospace Text: Fira Mono Regular 11
Legacy Window Titles: Fira Sans SemiBold 10

Hinting: ○ Full ○ Medium ● Slight ○ None

Antialiasing: ○ Subpixel (for LCD screens) ● Standard (greyscale) ○ None

Scaling Factor: 1.25 − +

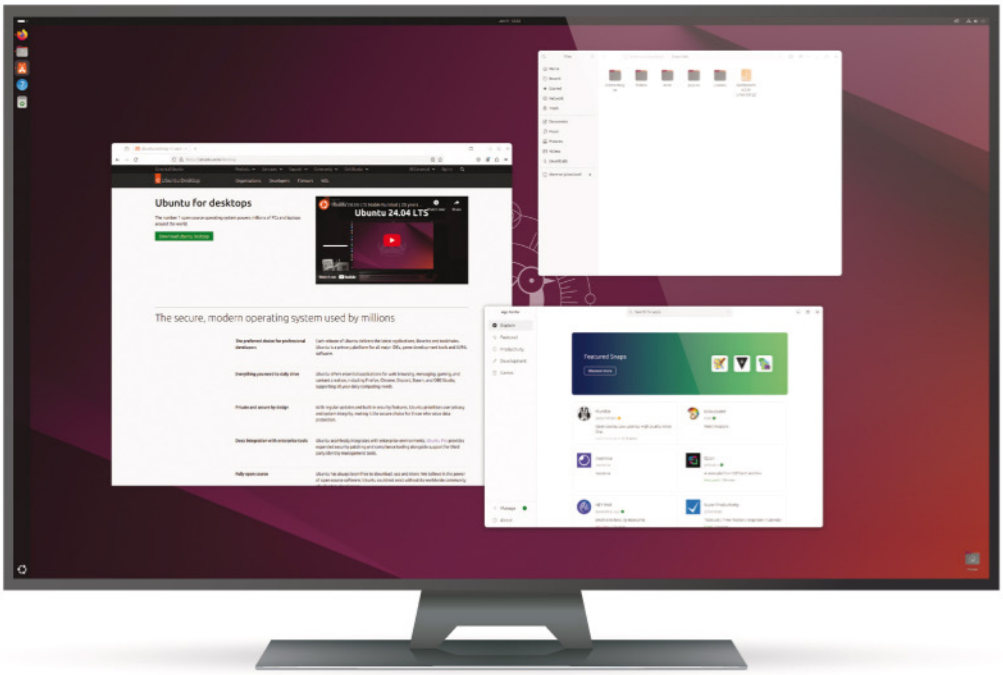
UBUNTU 24.10

Like Fedora, a fine choice for Windows switchers and everyone else thanks to great support and features.

★★★★★

WEBSITE ubuntu.com

2GHz DUAL CORE CPU | **4GB** MEMORY | **25GB** DISK SPACE



ABOVE The full-height panel on the left of the screen is a distinctive Ubuntu feature.

Ubuntu is possibly the best-known desktop distribution among consumers – and with good reason. Not only is it fully featured and frequently updated, it's also the basis of many other distros, including Zorin OS, Elementary OS, Pop!_OS and Linux Mint. That might surprise you when you consider how different they each look, but it's like Android phone manufacturers putting their own skin and refinements on Google's stock OS. As a result, Ubuntu is well supported and has a large user base, which can help when searching for answers.

You can choose between minimal and full installations, with the former featuring just a narrow selection of software, including Firefox but no email client or office suite. The full build rolls in LibreOffice, Rhythmbox media player, Shotwell photo organiser, Thunderbird and Gnome Calendar. Other essentials, such as GIMP, Inkscape and Scribus, are available for download through the App Centre or at the command prompt on either installation.

Ubuntu releases major updates every six months, with the version number indicating the year and month in which each one first appeared. Ubuntu 24.10, which we're reviewing here, was posted for download on 10 October 2024 and will receive support through to July 2025. Every fourth release is designated a Long Term Support (or LTS) build, which is supported for five years. Of these, the most recent is 24.04, for which support will extend through to April 2029. Many third-party distributions are based on LTS builds.

If you opt for Ubuntu LTS, we'd highly recommend signing up for Ubuntu Livepatch as part of Ubuntu Pro, which is free for personal use on up to five computers. It enables live patching of the kernel without the need to reboot, so you remain secure while reducing interruptions. It also extends the ongoing support window to ten years. With Ubuntu Pro, 24.04 LTS is supported until April 2034, and legacy support continues to April 2036 (although by this point you will surely have upgraded to enjoy whatever innovations future releases deliver).

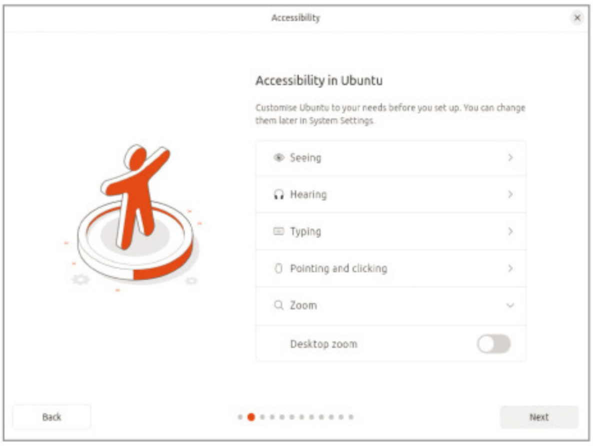
Ubuntu 24.10 is based on the 6.11 Linux Kernel and runs version 47 of the Gnome desktop environment, with Wayland handling screen output. These are all bleeding-edge releases, and Wayland in particular is seen by many to offer security and efficiency benefits over X11, which it looks likely to ultimately replace.

New users should have no trouble getting up and running. The installation wizard is well explained, makes some sensible assumptions, and lets you set your accessibility options (for sight, hearing, mobility and other issues) on the second dialog. Naturally, you can make the same changes inside the OS itself.

apc EDITOR'S CHOICE

apc BEST ON TEST

BELOW Accessibility options appear early as part of the Ubuntu onboarding process.



Accessibility

Accessibility in Ubuntu

Customise Ubuntu to your needs before you set up. You can change them later in System Settings.

- Seeing
- Hearing
- Typing
- Pointing and clicking
- Zoom
  - Desktop zoom

As we opted for a minimal installation in our tests, there were only two updates ready for download on first boot. Our wireless hardware had been detected – we used Ethernet during installation – and it had spotted our network printer without us manually installing any drivers.

The default look and feel is clean and uncluttered, and application windows have a full complement of minimise, maximise and close buttons (which is only worth mentioning as you can't take this for granted with other distributions). The Dock runs up the left edge of the screen by default, but you can move it to the right or bottom, and set it to float or auto-hide.

There are default and dark themes in a range of colours, and the standard font – Ubuntu Sans – is easy to read, although we do prefer Cantarell, as used by Gnome in Fedora. Naturally, you can change resolution and scale directly, but if you want to make any significant changes, such as picking a different system font, you'll need to install Gnome Tweaks (free from the App Centre).

There's no denying that Gnome, which Ubuntu uses by default, looks significantly different to Windows, but here it includes Ubuntu Dock – a bespoke component that's reminiscent of the taskbar seen in both Windows and other distros. System settings are clearly explained and easily navigated, and everything is set up from first boot, with an onboarding process that doesn't require much more than a handful of clicks. If you have the headspace to switch back and forth between a desktop and mobile operating system, getting to grips with Ubuntu shouldn't be a challenge.

View from the Labs

Five years into his Linux switch, Nik Rawlinson explains why he will never go back – and why he thinks APC readers should follow his lead.

So long, Windows 10. As mentioned at the outset, Microsoft will end support from its decade-old operating system later this year. So, if you haven't already upgraded to Windows 11, now would be a good time to consider your next step. Sticking with Windows is one option but, as our reviews hopefully show, switching to Linux is a viable alternative.

The last time I wrote a Linux Labs, I said the platform had come of age: nothing that's happened since then has changed my mind. Together, the various distributions cater for just about any requirement, whether that's photo editing on a high-end workstation or breathing new life into a decades-old machine that would otherwise head for recycling.

In devising this Labs, I took the centre ground. My test machine was a Dell OptiPlex 3060 from 2018, which was running Windows 10 when I picked it up, second hand, for a bargain $250. With a Core i5-8500T processor, 8GB of memory and a 256GB SSD, its specs are rather conservative when compared to more modern hardware, but I consider it typical of the kind of a machine that a Windows switcher might consider upgrading to Linux – perhaps while buying a faster, smarter machine for Windows 11 if they choose to head in that direction.

Nik Rawlinson is a former editor of MacUser but switched to Linux in 2020.

LEFT **All the distros in this Labs ran well on a second-hand Dell PC.**

"With every release, these Linux distributions become more capable and, for the most part, more attractive and easier to use"

As you'll see from our tests, each of the distros was more than capable of getting the best from my vintage PC. They ran smoothly and swiftly, and most were ready to use from first boot. Even those that weren't needed just a few tweaks to sort out.

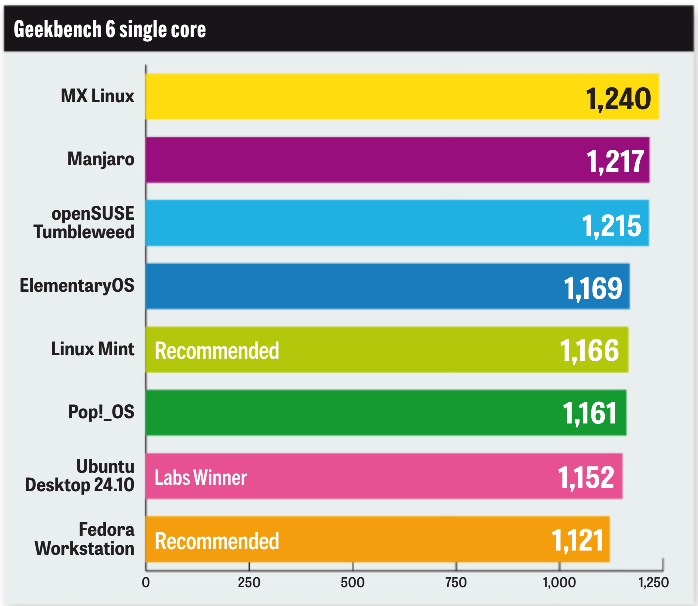
In fact, these distributions did so well, and proved once and for all that Linux is no longer an operating system solely for the technically minded, that in some cases I was forced to hunt for anything negative to say.

Linux isn't only a way of keeping old PCs running longer, though – nor of avoiding the upgrade to an operating system with AI smarts. Rather, it's a true alternative to the "mainstream". I've been using Linux on my primary desktop for the past five years, day in, day out, and while I use Windows for testing and macOS for graphics work, I have no plans to return to either of them full time for regular office work.

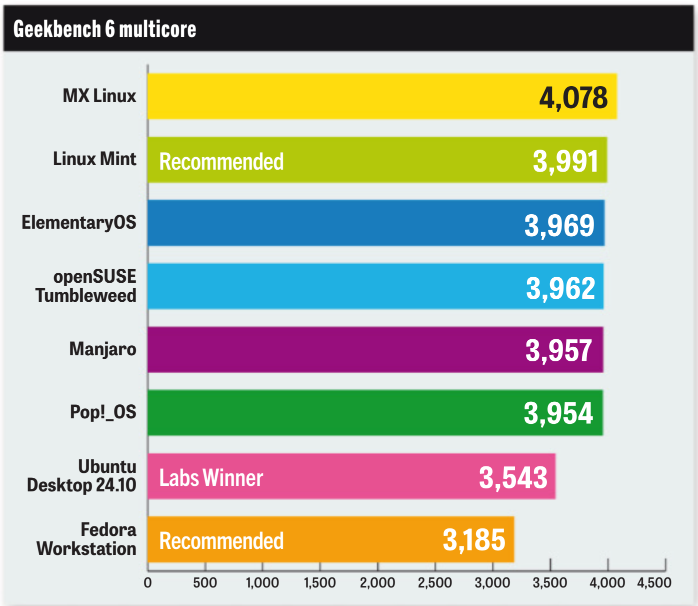
With every release, these Linux distributions become more capable and, for the most part, more attractive and easier to use. KDE and Gnome both look sharp and fresh, and their adoption by multiple distributions means you're not tied to a single provider: you can chop and change distro as often as you like but use the same UI wherever you end up. Better yet, many distributions now benefit from platform-agnostic package installers such as Flatpak, which make it all but certain you'll be able to run whichever app you need, whichever distribution you happen to be using. Using a tool such as Flatpak also saves you the chore of learning different commands for different distros when installing at the console.

If you haven't tried Linux yet, I urge you to give it a go. Either buy a cheap second-hand machine, as I did, use a host utility like VirtualBox to run it inside Windows or macOS, or set up your main machine to dual boot (but back up everything first). And, if you briefly encountered Linux many years ago but it didn't work out, now would be a great time to get yourself reacquainted. You may find that whatever put you off last time around has been solved or obsoleted. ■

Test results



Geekbench 6 single core



Geekbench 6 multicore

Test rig: Dell OptiPlex with Core i5-8500T and 8GB RAM

NAS DRIVES STORAGE AND BEYOND

With our guide to the best NAS devices currently available, you can take control of your files and run your own private cloud.

Despite cloud storage's prevalence and ubiquity, the humble network-attached storage (NAS) device is still an attractive proposition. Two obvious reasons are space and money.

While 1TB of cloud storage may seem like a lot and can be picked up relatively cheaply (or even bundled with a Microsoft 365 plan), it's an ongoing cost, and that storage space isn't as much as you might think.

Fill it up with your music collection, every file you've owned and a load of videos, and 1TB disappears quickly. With your own NAS, you're master of your storage needs and can start with a lot more storage than you get online, even with an entry-level device.

A NAS is about more than just physical storage, though. It's a way of controlling what you own without paying for the privilege. Thanks to the apps that Asustor, Qnap, Synology and TerraMaster provide, you can still enjoy the effects of a Dropbox-like system, but your data is synchronised to your own server.

A NAS device is also multifunctional. Additional apps can turn it into a web server or a UPnP server for your music. Install Plex, and

you can stream any videos and films you've stored digitally, making your version of Netflix with content you own and with no monthly cost.

Buy the right kinds of security cameras, and you can stream and store security footage to your NAS, giving you way more storage than any cloud system. Did someone say Ring?

Whether these features sound interesting or you want a large bucket of storage for backups, this comprehensive review of NAS devices will help you find the right device for your needs.

CONTRIBUTOR David Ludlow

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	RECOMMENDED		RECOMMENDED	RECOMMENDED	LABS WINNER
	2-BAY NAS DRIVES				**4-BAY NAS DRIVES**
	Asustor Drivestor 2 Pro AS3302T	**Qnap TS-233**	**Qnap TS-264**	**Synology DiskStation DS723+**	**Asustor Nimbustor 4 Gen2 AS5404T**
Price and supplier					
Rating	★★★★☆	★★★☆☆	★★★★☆	★★★★☆	★★★★★
Model number	AS3302T	TS-233	TS-264	DS723+	AS5404T
Price as reviewed [1]	$439	$399	$729	$849	$879
Manufacturer's website	asustor.com	qnap.com	qnap.com	synology.com	asustor.com
Warranty	3yr	2yr	3yr	3yr	3yr
Storage specifications					
Type	Barebones NAS	Barebones NAS	Barebones NAS	Barebones NAS	Barebones NAS
SATA drives	2 (3.5in or 2.5in)	2 (3.5in or 2.5in)	2 (3.5in or 2.5in)	2 (3.5in or 2.5in)	4 (3.5in or 2.5in)
M.2 drives	✗	✗	2 (NVMe PCIe Gen 3)	2 (NVMe PCIe Gen 3)	4 (NVMe PCIe Gen 3)
Other drives	✗	✗	✗	✗	✗
RAID support	RAID0, RAID1, JBOD	RAID0, RAID1, JBOD	RAID0, RAID1, JBOD	RAID0, RAID1, JBOD, SHR	RAID0, RAID1, RAID5, RAID6, RAID10, JBOD
Claimed max read speed	216MB/sec	114MB/sec	589MB/sec	475MB/sec	599MB/sec
Claimed max write speed	275MB/sec	103MB/sec	589MB/sec	225MB/sec	599MB/sec
Hardware encryption	✗	Accelerated	Accelerated	Yes	✗
Core specifications					
CPU name	Realtek TRD1296	Not specified	Intel Celeron N5095	AMD Ryzen R1600	Intel Celeron N5105
CPU cores	4 (Cortex-A53)	4 (Cortex-A55)	4 (Jasper Lake)	2 (Zen)	4 (Jasper Lake)
CPU base speed	1.4GHz	2GHz	2GHz	2.6GHz	2GHz
Supplied RAM	2GB	2GB	8GB	2GB	4GB
Maximum RAM	2GB	2GB	16GB	32GB	16GB
Physical design					
Ethernet ports	1 x 2.5GbE	1 x 1GbE	2 x 2.5GbE	2 x 1GbE	2 x 2.5GbE
USB-A 2 ports	✗	2	2	✗	✗
USB-A 3.2 ports	3 (Gen 1, 5Gbits/sec)	1 (Gen 1, 5Gbits/sec)	2 (Gen 2, 10Gbits/sec)	1 (Gen 1, 5Gbits/sec)	3 (Gen 2, 10Gbits/sec)
USB-C 3.2 ports	✗	✗	✗	✗	✗
Expansion options	Additional drives via USB	Additional drives via USB	2 x PCIe Gen 3 slots supporting 10GbE or 2 x QM2 NVMe expansion cards, multiple tower and rack-mount expansion enclosures	PCIe Gen 3 x2 network upgrade slot, eSATA port	AS6004U HDD expansion via USB
Dimensions (WDH)	170 x 114 x 230mm	92 x 158 x 186mm	105 x 165 x 227mm	106 x 223 x 166mm	174 x 230 x 170mm
Extras					
Bundled software	Download Center, Looks Good, Photo Gallery 3, Surveillance Center	Qsync Central, Download Station, Photo Station, Video Station	Qsync Central, Download Station, Photo Station, Video Station	Synology Drive, Synology Surveillance Station, Synology Office, Synology Photo	Download Center, Looks Good, Photo Gallery 3, Surveillance Center
Supplied accessories	1 x Cat5e cable	2 x Cat5e cables	2 x Cat5e cables	2 x Cat5e cables	2 x Cat5e cables

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[1] Prices correct at time of going to press but are subject to change

RECOMMENDED	**RECOMMENDED**			**RECOMMENDED**
			5-BAY+ NAS DRIVES	
Qnap TS-464	**Synology DiskStation DS923+**	**TerraMaster F4-424 Pro**	**Qnap TS-h973AX**	**Synology DiskStation DS1522+**
★★★★☆	★★★★☆	★★★☆☆	★★★☆☆	★★★★☆
TS-464	DS923+	F4-424 Pro	TS-h973AX	Synology DiskStation DS1522+
$999	$839	$1,049	$1,596	$1,299
qnap.com	synology.com	terra-master.com	qnap.com	synology.com
3yr	3yr	2yr	3yr	3yr
Barebones NAS	Barebones NAS	Barebones NAS	Barebones NAS	Barebones NAS
4 (3.5in or 2.5in)	4 (3.5in or 2.5in)	4 (3.5in or 2.5in)	7 (5 x 3.5in, 2 x 2.5in)	5 (3.5in and 2.5in)
2 (NVMe PCIe Gen 3)	2 (NVMe PCIe Gen 3)	2 (NVMe PCIe Gen 3)	✗	2 (NVMe PCIe Gen 3)
✗	✗	✗	2 x U.2 (NVMe PCIe Gen 3)	✗
RAID0, RAID1, RAID5, RAID6, RAID10, JBOD	RAID0, RAID1, RAID5, JBOD, SHR	RAID0, RAID1, RAID5, RAID6, RAID10, JBOD	RAID0, RAID1, RAID5, RAID6, RAID10, JBOD	RAID0, RAID1, RAID5, RAID6, RAID10, SHR, JBOD
589MB/sec	592MB/sec	283MB/sec	1,167MB/sec	736MB/sec
589MB/sec	562MB/sec	283MB/sec	929MB/sec	796MB/sec
Accelerated	Yes	Yes	Accelerated	✓
Intel Celeron N5095	AMD Ryzen R1600	Intel Core i3-N305	AMD Ryzen Embedded V1500B	AMD Ryzen R1600
4 (Jasper Lake)	2 (Zen)	8 (Alder Lake-N)	4 (Zen)	2 (Zen)
2GHz	2.6GHz	1.8GHz	2.2GHz	2.6GHz
8GB	4GB	32GB	8GB	8GB
16GB	32GB	32GB	64GB	32GB
2 x 2.5GbE	2 x 1GbE	2 x 2.5GbE	2 x 2.5GbE, 2 x 10GbE	4 x 1GbE
2	✗	✗	✗	✗
2 (Gen 2, 10Gbits/sec)	2 (Gen 1, 5Gbits/sec)	1 (Gen 2, 10Gbits/sec)	2 (Gen 2, 10Gbits/sec)	2 (Gen 2, 5Gbits/sec)
✗	✗	1 (Gen 2, 10Gbits/sec)	1 (Gen 2, 10Gbits/sec)	✗
2 x PCIe Gen 3 supporting 10GbE or 2 x QM2 NVMe expansion cards, multiple tower and rack-mount expansion enclosures	PCIe Gen 3 x2 network upgrade slot, eSATA port	Various desktop attached storage enclosures via USB	Multiple tower and rack-mount expansion enclosures	PCIe Gen 3 x2 network upgrade slot, 2 x eSATA ports
170 x 165 x 227mm	199 x 223 x 166mm	179 x 154 x 222mm	177 x 225 x 224mm	166 x 230 x 223mm
Qsync Central, Download Station, Photo Station, Video Station	Synology Drive, Synology Surveillance Station, Synology Office, Synology Photo	Terra Photos, TerraSync, Surveillance Manager	Qsync Central, Download Station, Photo Station, Video Station	Synology Drive, Synology Surveillance Station, Synology Office, Synology Photo
2 x Cat5e cables	2 x Cat5e cables	1 x CAT 6 cable	2 x Cat5e cables	4 x Cat5e cables

Questions you need to ask before buying a NAS drive

There's one easy way to avoid buyer's remorse when purchasing a NAS drive, and that's to have answers to these key questions before you reach for your card.

DS723+
Syno
asustor
TERRAMASTER

ABOVE Your chosen device should come with at least two bays.

Q How many bays do I need?

Avoid single-bay NAS devices. These are effectively external hard disks with a network port. While they offer the same features as other NAS devices, they have one big problem: if the hard disk dies, all your data goes.

At the minimum, you should opt for a two-bay system. That way, you can install two hard disks and use RAID1 (mirroring), where data is written to both disks simultaneously. Should one hard disk fail, your data is safe, and you can swap the broken disk for a new one. It's worth swapping quickly to prevent the risk of complete data loss.

The downside of a two-bay NAS system is that with a RAID1 configuration you only get half the total capacity of both disks. Don't be tempted to use a different RAID configuration to get more storage, as you risk losing your data.

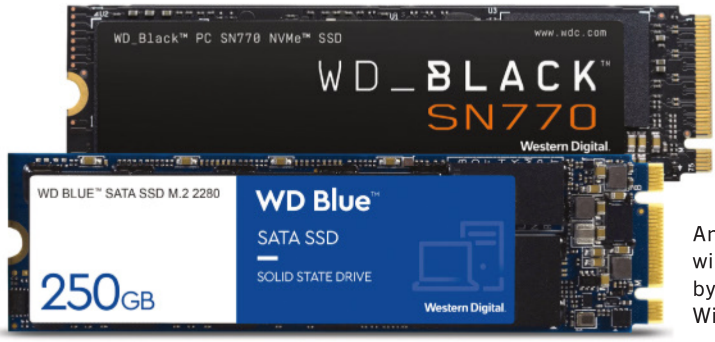
A four-bay NAS gives you more flexibility and a wider choice of RAID modes. With three or four disks (or more if you opt for a five-bay or higher model), you can use RAID5 or a proprietary equivalent. With these RAID levels, you're protected if any one disk fails, yet also enjoy the total capacity of all disks minus one. For example, install four 1TB hard disks, and you can use 3TB of space.

> **At the minimum, you should go for a two-bay system. That way, you can install two hard disks and use RAID1 (mirroring)**

Q Should I configure RAID for performance or data security?

With two or more disks, you can use RAID to expand the total storage by pooling multiple hard disks together. See p75 for the difference between RAID levels, but the important factor to look for is whether the RAID level you want gives you better performance, protects you from a hard disk failure or both.

Unless your data is reliably backed up elsewhere, we suggest that you implement the level of RAID that gives you the best performance while protecting you from a hard disk failure.



BELOW Many devices use NVMe SSDs, and most take M.2 SSDs.

Q Do I need a NAS device that works with NVMe SSDs?

An increasing number of NAS devices will take NVMe SSDs, as popularised by modern laptops and desktop PCs. With some NAS devices, you can use NVMe drives as extra-fast storage, with the added advantage that solid-state drives are silent.

However, in most cases, NVMe drives aren't for storage but caching, speeding up how quickly files can be sent to, or read from, your NAS device. If you regularly write a lot of files to your NAS and use it more like a hard disk, then it's a worthy upgrade.

Most NAS devices will take M.2 2280 SSDs, but check compatibility before you buy. Also check the advised size of drives that you'll need, as this varies by the total amount of storage that you have installed. Typically, most NAS providers have this information online or via the web interface for their products, providing a list of compatible products.

In most cases, a NAS will require two NVMe drives configured as RAID1 for a read/write cache, as redundancy is required. Again, you can buy NAS-specific SSDs, such as the Western Digital Red range, which are designed to be used in the close confines of a NAS enclosure.

Q What kind of network connection should my NAS have?

A NAS device will, at minimum, have a gigabit Ethernet port. Gigabit Ethernet is pretty fast, but it tops out at around 113MB/sec. A faster Ethernet connection will pay dividends if you've got a fast hard disk or solid-state caching (or storage), or you need to share the storage with multiple users.

Many modern NAS devices now ship with a 2.5GbE connection, which has the advantage that it will run across existing Cat5e cabling, and many new mesh Wi-Fi systems have these ports as standard.

A faster connection improves transfer speeds, provided your computer is connected via 2.5GbE or a fast Wi-Fi 7 connection. And you get more bandwidth to share between devices: with 2.5GbE, two gigabit Ethernet users will still get fast transfer speeds.

Some NAS devices can be upgraded with a 10GbE connection. This should be connected via Cat6 cabling (up to 55m) or Cat6a (up to 100m), although you should be able to run it over Cat5e over distances of up to 45m.

10GbE is becoming more common on high-end routers and mesh systems. Its main advantage is the total amount of bandwidth available. If you want a NAS for business use and have many heavy users, 10GbE may be the way to go.

It's common for many NAS devices to have two Ethernet ports. These can be used to add redundancy, so that your NAS is still online should one port fail, or to expand bandwidth by providing two connections. In a business, you could also connect each port to a different subnet.

Q What about apps?

Most modern NAS systems provide all the basic services you need right out of the box, including protocols for talking to Windows, macOS and Linux clients. They will also integrate with Apple's Time Machine backup service – you can turn this on with a click – so you can keep your Mac clients effortlessly backed up. For corporate deployments, many NAS units also support iSCSI and Active Directory, while most offer some form of remote access, both for management and for features and services.

Even so, have a browse through the apps available as these can extend the capabilities of your NAS appliance in all sorts of ways. All the units here come with an app store containing tens of additional apps. These invariably include a selection of media server apps, which allow your NAS to stream audio and video to smart devices in your home. Most apps are free, although occasionally you'll need a licence to add functionality.

In addition, you'll find business and development tools, surveillance tools that work with IP cameras, and even content management systems such as WordPress. Some even offer rivals to Google Docs. Furthermore, it's now common to find support for virtualisation through Docker.

eero
eero
eero

ABOVE **Many Wi-Fi mesh systems support 10GbE connections.**

If an app you want to use isn't listed in the store, it may be possible to install it manually, but for obvious reasons we don't recommend this unless you're confident in your technical abilities.

One caveat: you'll need a powerful NAS to run a whole load of apps and services. It's a good idea to pick one with an Intel or AMD processor. And make sure there's plenty of RAM or that you can add more. If you're unsure about how much headroom you have, there's usually an activity monitor available within the appliance's web interface, exposing what's using its CPU and RAM, so you can spot any services that might be overtaxing your hardware.

You'll need a powerful NAS to run a whole load of apps and services. It's a good idea to pick one with an Intel or AMD processor

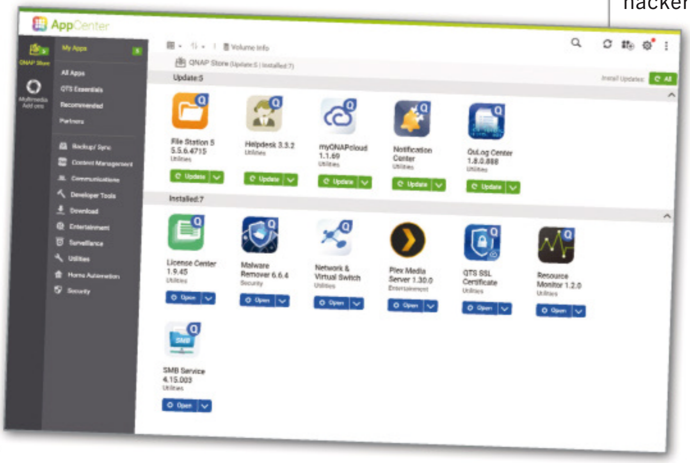
Also bear in mind that your internet connection could limit your NAS's ability to serve web pages or provide remote access to family members or employees. Most routers and some NAS enclosures let you set rules to manage bandwidth, but it's worth taking into consideration.

Q Can I access my files remotely?

It used to be hard to set up secure remote access to your NAS, but these days every manufacturer makes it simple to find and connect to your server. This could prove to be a tremendously useful alternative to cloud services such as Dropbox and Google Drive, with no monthly fees and a lot more storage. It could also reduce your environmental impact, particularly if your NAS runs on a green energy source such as solar power.

Many providers offer some degree of integration with third-party cloud services, so – for example – you can easily ensure that the files in a certain folder on your NAS appliance are synchronised with your Dropbox or Google Drive account. This can be handy if your home or office printer supports the same service, as it saves you having to mess around manually moving files back and forth.

BELOW **Apps can extend your NAS device's capabilities in all sorts of ways.**


AppCenter
QNAP Store
Multimedia Add-ons
My Apps
5
All Apps
QTS Essentials
Recommended
Partners
Backup/ Sync
Content Management
Communications
Developer Tools
Download
Entertainment
Surveillance
Utilities
Home Automation
Security
Volume Info
QNAP Store (Update:5 | Installed:7)
Update:5
Install Updates:
All
File Station 5
5.5.6.4715
Utilities
Update
Helpdesk 3.3.2
Utilities
Update
myQNAPcloud
1.1.69
Utilities
Update
Notification Center
Utilities
Update
QuLog Center
1.8.0.888
Utilities
Update
Installed:7
License Center
1.9.45
Utilities
Open
Malware Remover 6.6.4
Security
Open
Network & Virtual Switch
Utilities
Open
Plex Media Server 1.30.0
Entertainment
Open
QTS SSL Certificate
Utilities
Open
Resource Monitor 1.2.0
Utilities
Open
SMB Service
4.15.003
Utilities
Open

Q What do I need to know about security?

The first thing to remember is that even with data redundancy, RAID isn't infallible. Your NAS could be fried in a fire or stolen in a break-in. It's a good idea to consider an offsite backup; many NAS systems come with integrated support for systems such as Amazon S3 or ElephantDrive, which will store very large amounts of data for a (comparatively) modest monthly fee.

Alternatively, if you have access to a NAS appliance in a second location, most units will let you replicate your data over the internet, using either the industry-standard rsync utility or a bespoke service.

Remember that a modern NAS is in effect a fully featured computer, which may be susceptible to online attacks. You should install system updates as soon as possible – most NAS devices can be set to do this automatically in the middle of the night.

Make sure your apps and services are up to date, too: platforms such as WordPress are frequently exploited by hackers. Finally, don't forget that your NAS's on-board security can't protect you from malware that's running on a PC and abusing your credentials to tamper with your data. Some ransomware specifically targets NAS appliances. The best defence is to make sure your clients are properly patched and virus-free, but we also recommend you configure snapshot protection, which is widely available if you format with the Btrfs file system.

Asustor Drivestor 2 Pro AS3302T

Although relatively cheap, this two-bay NAS has the performance and features to match high-end enclosures.

★★★★☆

PRICE $439
asustor.com

asustor
apc
HIGHLY RECOMMENDED

Although an entry-level two-bay NAS enclosure, the Asustor Drivestor 2 Pro AS3302T punches above its weight, delivering a level of performance that puts it above its budget rivals. The slight lack of upgradability will put off those who want more from their NAS device, but if you have more basic needs, this is an excellent device.

The two SATA hard disk bays are hidden behind a magnetic panel on the front. There are no locks on the drive caddies, but the panel will at least stop the casual fiddler from messing with running hard disks.

Both drive bays use a screwless design, so you can quickly pop the disks in and have the NAS ready to go in a matter of minutes. We did struggle with the hard disk clips, which are tough to remove, and had to resort to a screwdriver to pry them free.

There are screws at the back to get inside; not that you'll need to, as there are no M.2 slots for SSDs, and the 2GB of RAM is fixed and non-upgradable.

That doesn't sound like a lot of RAM, but the quad-core Realtek RTD1296 Arm CPU is efficient and doesn't need more memory for day-to-day use. However, if you want to run a lot of apps, it makes sense to buy a NAS with more RAM or the ability to upgrade.

We'd expect a NAS at this price to ship with a gigabit Ethernet port, but the AS3302T has a 2.5GbE port at the back. Gigabit Ethernet tops out at slower-than-hard-disk speeds, while a 2.5GbE port lets you maximise the disks you install. There's just a single Ethernet port here, which is fine for home use but means businesses should approach with caution.

Although there are two storage bays, the AS3302T is technically expandable to 14 bays with USB-A expansion ports via three 5Gbits/sec USB 3.2 Gen 1 ports. Realistically, if you need more storage, you'll want to buy a NAS with more bays from the start.

The AS3302T runs Asustor's ADM operating system, which is easy to use and fully featured. It was quick to set up our NAS with a RAID1 array and then create a shared folder for access. If you want apps, Asustor App Central is great, with hundreds of apps to choose from, covering everything from networking, camera surveillance, media streaming and file synchronisation. There's even onboard 4K transcoding, available through the LooksGood media player, which shows what the Arm chip is capable of.

With EZ-Connect, which requires an Asustor ID, you can easily connect remotely to the NAS from outside of your home network, which makes it much simpler to get some of the apps working.

Asustor claims a blistering 216MB/sec read speed and a 275MB/sec write speed for the AS3302T, which should put it above other two-bay NAS enclosures without SSD caching.

Indeed, this proved a very fast two-bay NAS in most of our tests, only struggling in the ATTO 4K benchmark, recording a write speed of 16MB/sec and a read speed of 21MB/sec. This could be due to the combination of lightweight processor and relatively small amount of RAM.

With larger files, things improve a lot, with the Drivestor 2 Pro AS3302T recording write speeds of 231MB/sec and read speeds of 196MB/sec in the ATTO 2MB benchmark. Here, the 2.5GbE connection allows the NAS to surpass the speeds of the enclosures that have only a 1GbE connection.

In our real-world file copy tests, the Asustor Drivestor 2 Pro AS3302T managed write speeds of 134MB/sec and read speeds of 125MB/sec. That's behind the absolute best in this test, dominated by those with four bays, but still faster than any enclosure with only a 1GbE port. Notably, the Asustor Drivestor 2 Pro AS3302T was generally faster in all our tests than its nearest competitor, the Qnap TS-233.

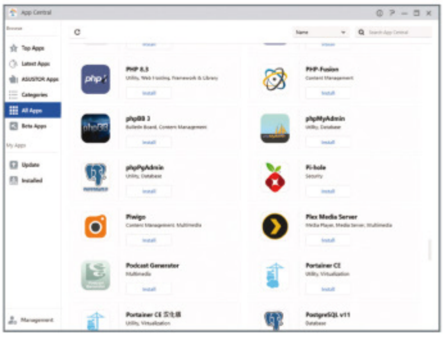
Overall, that makes the AS3302T the best choice for anyone who wants an entry-level two-disk NAS. The combination of price, performance and app choice is hard to beat.

This NAS does tend to top out with its transfer rates earlier than the four-bay devices that we've reviewed, and the 2GB of fixed RAM will get eaten up quickly if you want to run a lot of apps. For a small business, you'll probably want something with more resources; for home use, it's a bargain.

ABOVE **The two SATA hard disk bays are hidden behind a panel.**

LEFT **The rear 2.5GbE port is a pleasant surprise at this price.**

BELOW **Asustor's app store is packed with useful software.**



Qnap TS-233

A simple, cheap, two-bay NAS, the TS-233 is good for basic needs but lags behind in terms of performance.

★★★☆☆

PRICE $399

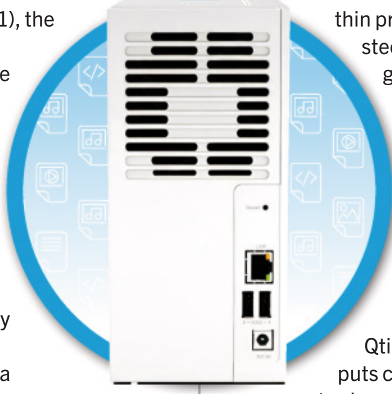
qnap.com

ABOVE The TS-233 is a basic NAS, with no room for expansion.

The first sign of this NAS drive's low price comes when you want to open it. While most NAS enclosures here are screw-free, Qnap's TS-233 isn't. Before you can install the hard disks, the bottom screw has to be removed, and then the case side removed. That's easier said than done, and we had to consult the manual as the side didn't want to budge at first.

Once open, you'll find two hard disk caddies that unclip and slide out. SATA hard disks can then be clipped in (fortunately, no screws are needed here) and then you simply slide the caddies back into place.

With the side open, it's clear that there are no further expansion opportunities: the Qnap TS-233 can't have its memory upgraded and doesn't have any M.2 slots for adding NVMe drives. Not that this NAS device is devoid of upgrade options. With three USB-A ports (two USB 2 and one USB 3.2 Gen 1), the Qnap TS-233 is technically compatible with Qnap's USB disk enclosures. However, the TS-233's USB ports and processor speed will limit what's possible; if you need more storage, buy a four-bay NAS from the start.



LEFT A single gigabit Ethernet port will limit transfer speeds.

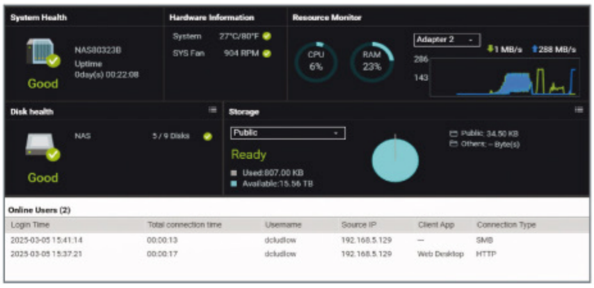
Internally, there's a simple four-core Arm Cortex-A55 processor and 2GB of non-expandable RAM. This CPU was launched back in 2017 and is a budget-friendly option. It will slightly limit what you can do with this NAS device. If you want to run lots of apps, then a NAS with a faster processor and more memory (or the option to upgrade) will be required. Similarly, the single gigabit Ethernet port at the rear limits the maximum transfer speeds that this NAS device can achieve, and there's no way to get a faster network connection.

All that said, the TS-233 is relatively quick and easy to get running. Once the hard disks are installed and the NAS powered on, the Qfinder Pro app can be used to detect it and connect to the management interface. This runs through a quick wizard to install the Qnap QTS operating system.

It's a decent OS, but it lags behind Synology DSM in terms of ease of use, with a more techie feel. That's clear when creating a storage pool. While it's good to have a choice between thick and thin provisioning, it's a steeper learning curve to get the right kind of storage pool. We opted for thick provisioning, using RAID1 to mirror data between the two 6TB WD Red drives that we were using.

Qnap now offers Qtier as an option. This puts cold, less-used data onto slow storage and says it uses fast SSD storage for hot data. That sounds nice in theory, but as the Qnap TS-233 doesn't have any SSD slots, we couldn't use the option.

Qnap has a fully loaded AppCenter with many add-ons available. For example, it's well worth turning on myQnapcloud to make it easy to connect to your NAS over the internet so that many of the apps will work properly. QSync is Dropbox-like file synchronisation software with clients for Windows, Mac, iOS and Android. While Qnap doesn't have its own office software, it can be integrated with Office Online for file editing.



System Health

NAS80323B

Uptime

0day(s) 00:22:08

Good

Hardware Information

System 27°C/80°F

SYS Fan 904 RPM

Resource Monitor

CPU 6%

RAM 23%

Adapter 2

1 MB/s 288 MB/s

Disk health

NAS 5 / 9 Disks

Good

Storage

Public

Ready

Used:807.00 KB

Available:15.56 TB

Public: 34.50 KB

Others: -- Byte(s)

Online Users (2)

Login Time	Total connection time	Username	Source IP	Client App	Connection Type
2025-03-05 15:41:14	00:00:13	dcludlow	192.168.5.129	—	SMB
2025-03-05 15:37:21	00:00:17	dcludlow	192.168.5.129	Web Desktop	HTTP

BELOW Qnap's QTS isn't as user-friendly as other OSes.

QVR Pro gives you surveillance camera recording, while QVR Face Insight adds an additional tool for facial recognition. There's also a wide range of media applications, including Plex, and photo, music and video servers. You'll also find the likes of WordPress, McAfee Antivirus and a range of backup software. Synology is slightly ahead in terms of apps, but Qnap covers a lot of the same ground.

Performance is predictably mixed. In the ATTO small file tests, the system was quite slow, managing 18MB/sec in the write test and 16MB/sec in the read test. It did better with larger file sizes, topping out at close to the maximum speed that gigabit Ethernet offers in the 2MB test.

In the real-world file backup test, we saw write speeds of 62MB/sec and read speeds of 79MB/sec, putting this product at the bottom of the performance table. As there's no SSD storage option, there's no chance to improve speeds.

If you're looking for a cheap and easy-to-use NAS, the Qnap TS-233 is a good but basic choice. Spend a little bit more on the Asustor Drivestor 2 Pro AS3302T, however, and you get similar features but better overall performance.

Qnap TS-264

This two-bay model offers a strong combination of price, performance and flexibility via slots for upgrades.

★★★★☆

PRICE $729

qnap.com

QNAP
apc
HIGHLY RECOMMENDED

ABOVE The TS-264 is great value and a fine performer.

The Qnap TS-264 is aimed at those who want a bit more from a traditional two-bay NAS. It's effectively the two-bay version of the excellent four-bay TS-464 that we review on p89; the latter is worth buying if you know you need more storage from the off.

Aside from having half the bays of its big brother, the TS-264 has many of the same benefits, including the dual 2.5GbE ports at the rear, which open the NAS up to faster transfer rates. If you want more, a PCIe Gen 3 x2 slot lies empty, ready and waiting for a dual-port 10GbE card.

There's a powerful 4-core Intel Celeron N5095 processor inside, which is paired with 8GB of DDR4 RAM. If you want to run more apps, you can add another stick of SODIMM RAM to upgrade the memory to 16GB.

As with the TS-464, the SATA hard disk bays are accessible from the front. A front panel has a simple slide lock on it, preventing anyone from accidentally pulling a disk out. Once this panel is off, hard disks can be installed tool-free.

If you want to use the dual M.2 NVMe slots, you will have to get a screwdriver out to remove the top panel. We prefer the more straightforward Synology approach, where M.2 slots can be accessed without any tools. While the four-bay version offers more flexibility in terms of RAID levels (with two bays, you get RAID0 or the preferred RAID1), it's good to have the option of using the NVMe drives as either a separate storage pool or for caching.

The Qnap QTS is a powerful and flexible operating system, even if it feels less friendly than Synology DSM. The range of apps is enormous, with choices from media streaming to security camera surveillance.

Performance from the TS-264 is just a little behind the TS-464 when using hard disks, as two drives in a RAID1 array are slower than four disks in a RAID5 array. Adding SSD caching to the TS-262 improved rates slightly. Our best results showed the TS-262 managed decent performance in the ATTO 4KB file test, with 29MB/sec read and 34MB/sec write speeds.

With the larger 2MB file test, the 2.5GbE connection showed its use with read speeds of 277MB/sec and write speeds of 234MB/sec. Our real-world test showed promising results, too, with read speeds of 145MB/sec and write speeds of 157MB/s. Switching to an all-flash array, the TS-264 managed faster speeds yet, near identical to those the TS-464 achieved (no surprise, given both devices have two M.2 slots).

If you need more capacity (now or in the future), then the TS-464 is a better buy, but if you're happy with a two-bay device and just want the best performance you can get, then this NAS enclosure is great value.

BELOW Dual 2.5GbE slots means file transfers are rapid.

Do I need special NAS hard disks?

We explain what hard disks you should buy to populate your NAS enclosure.

Technically, you can install any hard disk in a NAS. Although it's generally best to use the same type of disk in each slot – the same manufacturer, model and size – if you have spare hard disks lying around then there's no harm in using them.

If buying storage from scratch, you'll have a choice between standard desktop hard disks and models specially designed to be used in a NAS, such as the WD Red hard disks we used for this test. So, what's the difference, and do you really need NAS hard disks?

NAS hard disks have been explicitly designed to work in the confined spaces of a NAS enclosure and are intended to be operated 24 hours per day. As such, they're built to last longer and be more reliable.

For example, a WD Red 2TB Pro hard disk comes with a five-year warranty and can operate at temperatures of up to 65°C, while the WD Red Plus 2TB hard disk has a three-year warranty and can operate at temperatures of up to 65°C. Buy the equivalent WD Blue drive and get a two-year warranty and a drive that can operate at temperatures up to 60°C.

Another comparison is the Mean Time Between Failure (MTBF), which is the average operating time before a disk failure. This doesn't guarantee an operating life, but drives with a higher MTBF typically do last longer. A WD Red Pro has an MTBF of 2,000,000 hours. A WD Blue drive doesn't have a quoted MTBF, but it will be lower.

There's some additional technology in NAS drives, too. For example, with the WD Red Pro, there are Rotation Vibration (RV) sensors to counteract disturbances caused by chassis vibration, and shock protection.

If you're buying from scratch, it makes sense to buy hard disks specified for use in a NAS enclosure.

RIGHT WD Red drives have been specifically designed for NAS use.

WD
6 TB
WD6001FFWX
NASware 3.0
WD Red Pro
NAS Hard Drive
WD Red SA500
SATA SSD
SOLID STATE DRIVE
Western Digital

Synology DiskStation DS723+

A fully featured and expandable NAS, which is only let down by the lack of 2.5GbE ports.

★★★★☆

PRICE $849
synology.com

STATUS
DISK 1
DISK 2
Synology
DS723+
apc
HIGHLY RECOMMENDED

ABOVE The DS723+ is a powerful NAS that can be easily expanded.

Synology's top-of-the-range two-bay NAS device, the DS723+, is highly expandable, has lots of power and is easy to set up and install. It includes two Ethernet ports, but these are 1GbE rather than 2.5GbE, which feels outdated on such an expensive product.

But there's so much else here that is great. The DS723+ is a breeze to set up, as it's entirely tool-free. The two SATA hard disk bays on the front have simple keylocks to prevent anyone accidentally pulling a live drive out. Once unlocked, the caddies slide out, and hard disks can be quickly inserted.

If you want SSD caching, two NVMe slots are available underneath. Just remove the screw-free covers and insert the drives into the slots. It's brilliantly simple, whether you want to install the SSDs straight away or upgrade in the future.

LEFT Sadly, the two ports on the rear are of the 1GbE variety.

This NAS is powered by a dual-core AMD Ryzen R1600 CPU, running at a base clock speed of 2.6GHz with a 3.1GHz Turbo boost. That's powerful enough to handle a wide range of apps, although you may want to upgrade the 2GB of RAM. How fortunate, then, that this NAS has two DDR4 SODIMM sockets, which can handle a total of 32GB of RAM, more than enough for most users' needs.

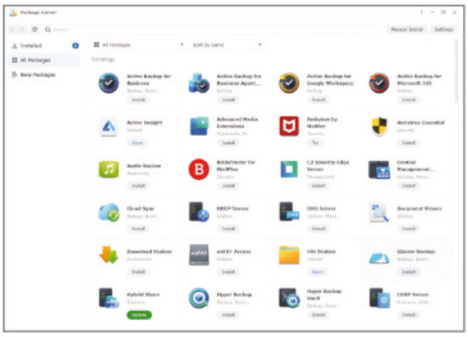
It's possible to aggregate the two 1GbE ports into one fat pipe, although the number of switches or routers that support this is limited. An upgrade card is available to add 10GbE into the mix, but that adds only one port and requires you to already have a switch or router with a compatible port.

You only get one USB-A port, but an eSATA connector helps compensate, with Synology's five-bay DX517 expansion bay supported. However, if you know you'll want more storage then it's probably better to go with a bigger NAS from the start, such as the Synology DS923+.

We have no complaints about the Synology DSM operating system. It's our favourite choice for NAS devices, starting with the desktop software that makes it easy to find and configure a new NAS.

Once the OS is installed, Synology DSM is a joy to use. It walks you through creating a RAID array, helping you find the best choice. Synology Hybrid Raid (SHR) is probably the best bet in most cases, as it supports disks of different sizes and makes it easy to grow the array size in the future. If you want to use SSD caching, DSM makes this easy, too, but you can't use the SSDs in their own storage pool. Once storage is created, the system even takes you through configuring shared folders. It's an absolute dream to use, and we doubt you'll need to turn to the help pages.

One advantage of DSM is the wide range of additional apps you can install, including many made by Synology itself. Synology Drive is great if you want your own Dropbox-style experience, complete with Android, iOS, Windows and Mac clients, while Synology Office gives you a Google Docs-style experience, even if the apps are more basic. There's also Plex for media streaming, Synology's own media server, a photo viewer and Surveillance Station for managing security cameras. In total, there are over 100 apps on offer, from WordPress and phpMyAdmin to Elephant Drive and a DNS server.



BELOW Synology's DSM lets you install over 100 extra apps.

Despite the 1GbE ports – did we mention them? – performance is strong. With an SSD cache, the Synology DS723+ managed to hit read/write speeds of 113MB/sec in the ATTO 2MB benchmark, which is the limit of the networking tech. Even its 4KB and 16KB results are close to other devices with faster Ethernet ports.

In our real-world copy tests, which use a combination of file sizes, read and write speeds were around the 100MB/sec mark with SSD caching and just below without. That's very good for gigabit Ethernet, but suggests that the NAS could go even faster if it had – well, you know what.

Overall, on a balance of features, performance and quality, there's a lot to like about the Synology DS723+. It's easy to upgrade, has a superb operating system and can handle a huge range of apps, making it more than a dumb file server. Faster network ports would be nice, but at least there's the option of adding 10GbE if needed. But if you need faster performance out of the box, there are better choices.

Asustor Nimbustor 4 Gen2 AS5404T

Powerful and well priced, this is a great choice for everything from streaming to running a small office.

★★★★★

PRICE $879

asustor.com

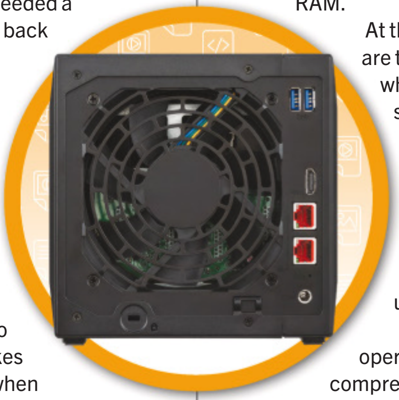
asustor
apc EDITOR'S CHOICE
apc BEST ON TEST

ABOVE **Asustor's AS5404T is great value and has lots of expansion potential.**

Built for those who demand the best performance, the Asustor Nimbustor 4 Gen2 AS5404T is a four-bay NAS that offers much more than most, with some nice surprises under its standard-looking exterior.

Like other Asustor NAS enclosures, the AS5404T hides its tool-free drive bays behind a magnetically connected fascia. That not only makes the outside look nicer but means that the drives can't be tampered with.

The drive caddies aren't locked and lift out with a simple lever action, making a disconcerting snapping sound as they come free. We struggled to get the caddy clips out and had to use a screwdriver to tease them out; they needed a hard push to put them back into place, too.



LEFT **The two 2.5GbE ports come in handy when shifting big files.**

The AS5404T takes up to four M.2 SSDs, but to get to the slots, the chassis must be taken apart by removing the screws at the back. The disk caddies also have to be removed, so if you use SSDs, it makes sense to install them when the NAS is new. If you want to upgrade later, make sure you know which order your hard disks came out in, so you can return them correctly.

Fiddly physical installation apart, the combination of four hard disks and four SSDs is powerful. For hard disks, the AS5404T supports all common RAID configurations, including RAID5, 6 and 10. With the M.2 slots, you can use the bays for caching, ultra-fast storage or a combination of the two. For example, a RAID1 pair could be used for caching, leaving you with a secondary RAID1 pair for fast storage. Few other NAS enclosures offer such flexibility in such a small case. Should you need more storage, you can hit up to 16 drive bays by using external expansion units, attached via the three USB-A 3.2 Gen 2 ports.

The quality continues throughout. Internally, the quad-core Intel Celeron N5105 processor is backed up by 4GB of RAM. You can upgrade this to 16GB using the two SODIMM slots, but that means discarding the pre-installed 4GB stick of RAM.

At the rear of the NAS are two 2.5GbE ports, which give you a head start over NAS enclosures that are limited to 1GbE speeds. We find that 2.5GbE is particularly important when using SSDs.

Asustor's ADM operating system is comprehensive and comes with a quick start guide to help you configure your storage automatically. However, you can choose manual configuration if you prefer. After creating a storage pool, the NAS takes a while to synchronise RAID arrays, but it's worth the wait.

One of the most impressive things about ADM is the fully stocked App Center, which is packed with hundreds of apps, covering networking, surveillance, productivity and entertainment. For the latter, 4K transcoding is supported, and there's even an HDMI 2.0b output so the NAS can be connected directly to a TV. That said, it's as easy to install a Plex server and stream content to a smart TV or TV stick. Whether you want to run a small business or move your media collection to a shared server, the Asustor AS5404T has the power and apps to help you.

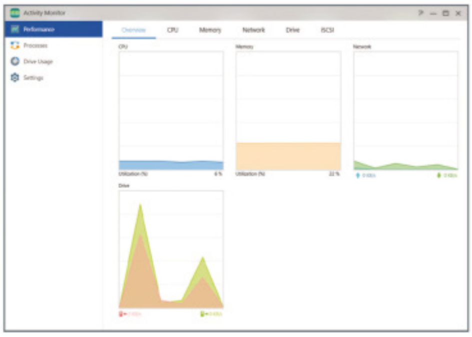
Performance is exceptional. In the ATTO 4KB file test, which is tough on resources, the AS5404T did brilliantly with hard disks, managing peak read speeds of 40MB/sec and write speeds of 36MB/sec with SSD caching (we recorded slightly slower performance with hard disks alone).

As soon as we moved to the large files test, the AS5404T showed the power of its 2.5GbE ports, achieving read speeds of 281MB/sec and write speeds of 217MB/sec. Real-world performance was impressive, too, with our file copy test showing read speeds of 203MB/sec and write speeds of 195MB/sec, which is just behind the TerraMaster F4-424 Pro.

Moving to an all-flash array, using three SSDs, performance was similar, although the PC Mark 10 Data Drive benchmark increased to 400, and our real-world test delivered blistering write read speeds of 234MB/sec.

In terms of pure raw speed, the TerraMaster F4-424 Pro just wins out, but it's fiddlier to set up and doesn't have the same range of apps. When you consider the brilliant price of this enclosure for its base specifications, and then its upgrade potential, it's a fantastic bit of kit and our Labs Winner.

BELOW **Asustor's operating system helps you keep track of performance.**



Qnap TS-464

Powerful, fast and easy to expand, the Qnap TS-464 is a brilliant four-bay device that's well suited to techies.

★★★★☆

PRICE $999
qnap.com

QNAP
apc
HIGHLY RECOMMENDED

ABOVE Qnap's TS-464 is a bigger brother to the two-bay TS-264.

Although it has a mid-range price, the Qnap TS-464 has the flexibility and performance of a more expensive device. It's also available in a two-bay version, the TS-264, which we review on p86.

While many NAS devices at this price offer only gigabit Ethernet, this device has two 2.5GbE ports, plus an expansion port if you ever need dual 10GbE ports. Inside, Qnap pairs an Intel Celeron N5095 processor with 8GB of RAM. That leaves a spare SODIMM slot that can take another 8GB stick of DDR4 RAM for a maximum of 16GB – handy if you want to run lots of apps on the NAS.

The four hard drive bays are located at the front of the NAS. They're covered by a panel with a simple slider that locks into place, which is good enough to prevent anyone from accidentally removing a disk while the NAS is in use. It's annoying that the two M.2 NVMe slots aren't accessible without a screwdriver. You must take the case apart to access these slots.

However, the Qnap TS-464 does offer some flexibility in organising storage. The four main hard disk bays support all of the main RAID types, including 5, 6 and 10. Separately, the NVMe SSDs can be provisioned as standalone fast storage or as an SSD cache for a hard disk-based pool.

Qnap's QTS operating system is one of the best, especially for techies, although it's not quite as easy to use as Synology's DSM. We have no complaints about the quality of the App Center, which has a huge range of downloadable options, including media servers, file synchronisation and security camera surveillance.

BELOW An expansion port lets you add to the two 2.5GbE ports.

With four hard disks running as RAID5, the TS-464 offers a small performance boost over the two-bay TS-264. Using an SSD cache gave a slight improvement over the raw hard-disk-only tests.

In the ATTO benchmark, the 4KB test completed with a decent read speed of 31MB/sec and a write speed of 37MB/sec, just ahead of its two-bay sibling. The gap increased with 16KB files, where the TS-464 managed write speeds of 112MB/sec, while the 2.5GbE ports showed their worth on the 2MB file test with a 283MB/sec write speed – the fastest in this group. Likewise, our real-world file copy test put the TS-464 towards the top of the table.

Used with SSDs in a RAID1 array, the TS-464 was quicker still, particularly in the 4KB file tests. However, the differences between flash storage and hard disks weren't quite as pronounced as you might think; we'd be tempted to use the NVMe slots for an SSD cache rather than dedicated storage.

At this price, the Qnap TS-464 is a hard combination to beat: it's fast, powerful and very flexible.

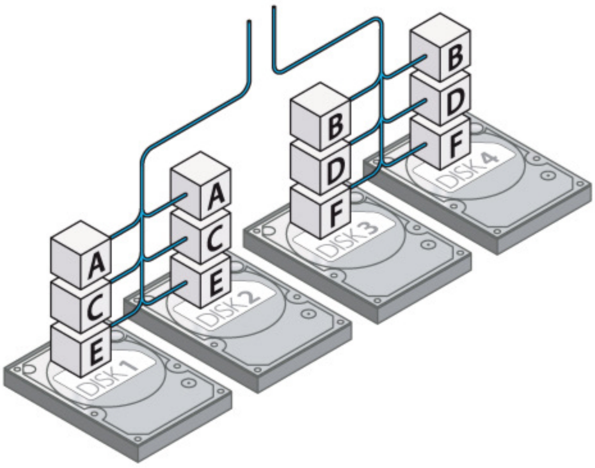
RAID levels explained

Ensure your data is protected by choosing the right RAID level for your needs.

A redundant array of inexpensive disks (RAID) lets you use multiple hard disks together in a single pool to boost capacity, data security or both. RAID0 is the most basic and is known as striping. Data is spread evenly across all the disks you have installed, so the total capacity is the total of the hard disks you have installed. Performance is excellent, but if any disk fails you lose all your data.

RAID1 is also called mirroring. It's most often used with two disks; the total storage capacity is the total capacity of all disks divided by two. Data written to one disk is mirrored to another disk, so if one disk fails, you have a complete backup.

Next comes RAID5, which is striping (RAID1) with parity (restoration data), and requires three or more disks. In short, it means that extra data is written across the hard disk pool, so that if any one hard disk fails, your data can be reconstituted. With RAID5, the capacity you get is the total of the disks combined minus one disk's worth. So, if you had three 2TB hard disks, you'd get a total capacity of 4TB. RAID5 gives the speed benefits of RAID0 with extra data protection.



ABOVE Using parity data and striping brings fast speeds and extra protection .

In a RAID6 configuration the parity data is doubled, so any two disks can fail without data loss. The total capacity is the number of disks minus two disks' worth.

RAID10 is a combination of RAID1 and RAID0. It requires at least four hard disks and an even number of them. Disks are split into two RAID0 pools and mirrored between them. As you can guess, you get half the capacity of the disk totals.

All of these systems need multiple disks of the same capacity to work (some systems let you mix hard disks but only use the space on the disk equal to the smallest hard disk). Some other systems, such as JBOD (standing for just a bunch of disks) and Synology Hybrid RAID, offer data protection but will work with a range of disk sizes.

Synology DiskStation DS923+

An expandable and flexible four-bay NAS that's great for small businesses despite its gigabit Ethernet ports.

★★★★☆

PRICE $839
synology.com

apc
HIGHLY RECOMMENDED
STATUS
DISK 1
DISK 2
DISK 3
DISK 4
Synology
DS923+

ABOVE **The DS923+ is an excellent choice for small businesses.**

The Synology DS923+ has been around for a few years now and remains a high-quality, upgradable four-bay NAS that's a great fit for small businesses.

This model shares a lot with the two-bay DS723+, but you only pay a little more for the extra two storage bays. And, while both devices have a dual-core 2.6GHz AMD Ryzen 1600 processor, the DS923+ has double the base memory at 4GB.

It's possible to upgrade the RAM to a maximum of 32GB if you use both SODIMM slots and don't mind discarding the existing stick of DDR4 memory. If you're going to run lots of apps, it could well be worth it.

The DS923+ uses Synology's brilliant screw-free design. The four drive bays at the front are all tool-free and unclip to slide out, but can be locked with the provided plastic key. Locking the drive bays will stop anyone accidentally popping a disk out while the NAS is running.

LEFT **The two 1GbE ports limit the device's performance.**

There are two M.2 2280 drive slots for NVMe drives (PCIe Gen 3), both located underneath the NAS. The compartment lids flip open and the drives can be inserted without screws. This makes it easy to add flash storage to the NAS either at the time of installation or later on. One minor restriction is that flash storage can only be used for caching, so you can't create a volume using only solid state storage.

The two gigabit Ethernet ports at the back of the NAS device feel old, when most similarly priced rivals use 2.5GbE. An expansion slot can take a 10GbE card with a single port, but this is quite an expensive upgrade.

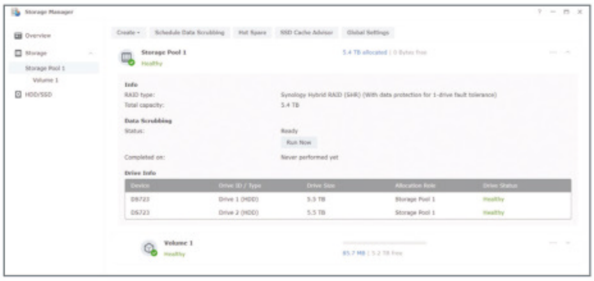
There are two USB-A ports for connecting external storage and an eSATA port for Synology's DX517 five-bay expansion chassis. Combined with the four bays in the main device, that gives a total possible capacity of 126TB across nine hard disks.

As with the company's other devices, the DS923+ is managed via the Synology DSM operating system, which remains best in class. After plugging in four 6TB WD Red hard disks, and turning the NAS on, we managed to get DSM installed and running in under ten minutes. DSM then took us through creating a RAID array using Synology Hybrid RAID (SHR), and the system was ready and waiting a few minutes later without the need for any lengthy RAID synchronisation.

It's just as easy to turn on caching with the addition of two NVMe drives. Cleverly, DSM takes you through the process and will only allow a read/write cache if you have two NVMe drives configured as RAID1.

As well as being hugely responsive, DSM is exceptionally easy to expand via the Package Center. The range of apps is quite staggering, with Synology having many of its own useful ones including Surveillance Station for security cameras; Synology Office (a Google Drive-style suite of applications); and Synology Drive for a Dropbox-like experience. Best of all, many of Synology's apps also have Android and iOS clients, alongside the traditional Mac and Windows ones.

BELOW **Synology's DSM operating system is excellent.**



Storage Pool 1
Healthy
5.4 TB allocated | 0 Bytes free

Info
RAID type: Synology Hybrid RAID (SHR) (With data protection for 1-drive fault tolerance)
Total capacity: 5.4 TB

Data Scrubbing
Status: Ready
Completed on: Never performed yet

Drive Info

Device	Drive ID / Type	Drive Size	Allocation Role	Drive Status
DS723	Drive 1 (HDD)	5.5 TB	Storage Pool 1	Healthy
DS723	Drive 2 (HDD)	5.5 TB	Storage Pool 1	Healthy

Volume 1
Healthy
85.7 MB | 5.2 TB free

Media support is superb, too, with Synology's own media server available alongside a photo app and Plex Media Server. You can also run MediaWiki, WordPress, Apache and phpMyAdmin, among other third-party apps.

For backups and synchronisation, there are apps for GoodSync, ElephantDrive and Cloud Sync that work with all the big cloud storage companies. Simply put, there are few other devices that can compete with what Synology has to offer, making the DS923+ a brilliant choice for small businesses that want more than just a big file store.

Testing over 1GbE, it feels as if this still-speedy NAS device could achieve more with a faster network connection. With SSD caching enabled, we managed to get throughputs of around 113MB/sec on the ATTO 2MB test, which is the limit of gigabit Ethernet.

A decent processor and powerful internals meant that the small file performance was stable, with read/write speeds on the ATTO 4KB test of around 32MB/sec. Backing up files in our real-world test, the DS923+ managed read speeds of 105MB/sec and write speeds of 92MB/sec. That's about as fast as you can get without a faster network connection.

There's no denying that the Synology DS923+ is crying out for a network upgrade to 2.5GbE, but even with its pair of 1GbE ports it remains a fast and powerful device that offers a lot to small businesses in particular.

TerraMaster F4-424 Pro

Extremely fast and powerful, this four-bay NAS is great for file storage, but its software lags behind.

★★★☆☆

PRICE $1,049
terra-master.com

ABOVE The F4-424 Pro is fast, but is hampered by relatively few apps.

Although it looks like the standard F4-424, the TerraMaster F4-424 Pro has all-new internals. And a higher price. However, that nets you an eight-core Intel Core i3-N305 CPU (3.8GHz boost speed) and memory slots pre-populated with 32GB of DDR5 RAM, so you're getting a lot for your money. The F4-424 Pro should be ready for anything you can throw at it.

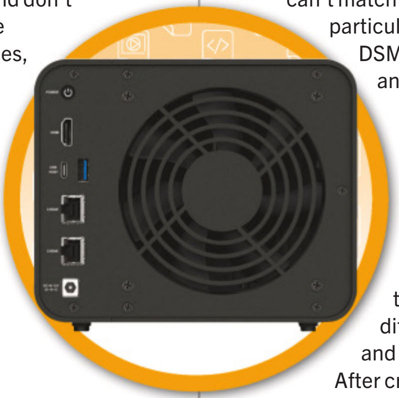
Build quality and usability are mixed. It's great to see four hot-swap hard disk caddies that slide out of the front, but they're not covered and don't have a lock. So, unlike Synology's NAS devices, anyone can pop out a disk whenever they want.

While the hard disks bays are tool-free, the two M.2 2280 NVMe slots (PCIe Gen 3) are only accessible when the case has been unscrewed and removed. That's inconvenient, both in terms of initial installation and for any future maintenance tasks. The dual SODIMM memory slots are also hidden behind this panel, but as the maximum of 32GB of RAM is already installed, you're unlikely to have to touch this.

As with the F4-424, the power button is located at the back, which is inconvenient if the NAS is placed on a shelf; however, given that this device is designed to run permanently, you won't need to get to the back often.

The rear also houses dual 2.5GbE ports, USB-C and USB-A ports and an HDMI output. There's no expansion port to upgrade to 10GbE, though, so look elsewhere if you need this.

The TerraMaster F4-424 Pro runs the company's TOS operating system (a great name that will be remembered fondly by anyone who had an Atari ST). When we first set the OS up, it defaulted to downloading TOS 5, although the newer TOS 6 is available. When we upgraded manually from TOS 5 to TOS 6, we had to recreate our admin username and password, although the storage we'd created remained intact. TOS 6 is a small step up from TOS 5, but functionally it can't match the competition, particularly Synology's DSM. At times, it's clunky and slow.



LEFT The rear is home to dual 2.5GbE, USB-C and USB-A ports, plus an HDMI output.

We set up the four-bay NAS with four 6TB WD Red hard disks, creating a storage pool using the company's proprietary TRAID; this supports different-size disks and easier expansion.

After creating these pools, we had to wait for RAID synchronisation, which took the best part of a day, although the system thoughtfully emailed us when it was complete. While synchronisation was going on, we couldn't configure the SSDs as an additional pool and had to wait for that task to finish.

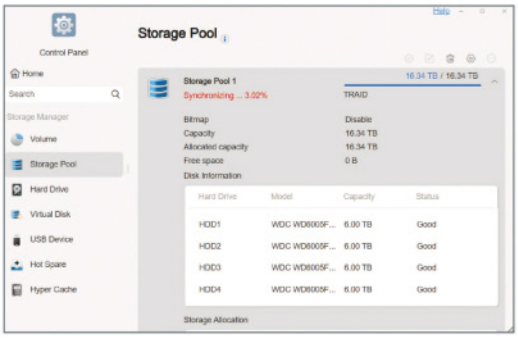
To test SSD caching, we used TerraMaster's Hyper Cache, which was again fiddly to configure: we had to remove the SSD storage pool and then format the SSDs to make the caching available. When setting it up, Hyper Cache would let us create a RAID0 array for caching, though it recommended RAID1.

The range of apps is much more limited here than with the competition, with only 22 official apps supported. There's Plex and a TerraMaster media server; several backup applications; TerraSync for a Dropbox-like experience on Windows and Mac (but not phones); and CloudSync for synchronising with Google Drive, OneDrive, Amazon S3, Dropbox and more. The community provides third-party apps, but they're all unofficial and don't have support. If you need a wider range of apps, you're realistically looking at buying a NAS from a rival.

While the operating system may not be as good as the competition's, the NAS is exceptionally fast. Kitted out with SSDs, the NAS peaked at 270MB/sec write speeds in the ATTO 2MB test and managed over 200MB/sec in our real-world mixed-file test. Even with hard disks installed (with and without SSD caching), the F4-424 Pro was swift. It's the 4K ATTO test that's particularly interesting, with the NAS light years ahead of the competition with hard disks, hard disks with caching and with SSDs.

Only the PCMark 10 Data Drive benchmark let the side down slightly, but there didn't seem to be any real reason why this would be the case.

The main issue here is that the limited range of apps makes it hard to fully load this NAS and take advantage of its processing power, making the older, cheaper TerraMaster F4-424 a better choice for people who want raw file performance. Otherwise, the Asustor Nimbustor 4 Gen2 AS5404T is a better bet for most buyers.



Storage Pool

Storage Pool 1
Synchronizing ... 3.02%
16.34 TB / 16.34 TB
TRAID

Bitmap Disable
Capacity 16.34 TB
Allocated capacity 16.34 TB
Free space 0 B

Disk Information

Hard Drive	Model	Capacity	Status
HDD1	WDC WD6005F...	6.00 TB	Good
HDD2	WDC WD6005F...	6.00 TB	Good
HDD3	WDC WD6005F...	6.00 TB	Good
HDD4	WDC WD6005F...	6.00 TB	Good

Storage Allocation

BELOW TerraMaster's OS is clunky and slow compared to its rivals.

Synology DiskStation DS1522+

Five bays gives extra storage flexibility to complement the powerful SMB-friendly software and hardware.

★★★☆☆

PRICE $1,299
synology.com

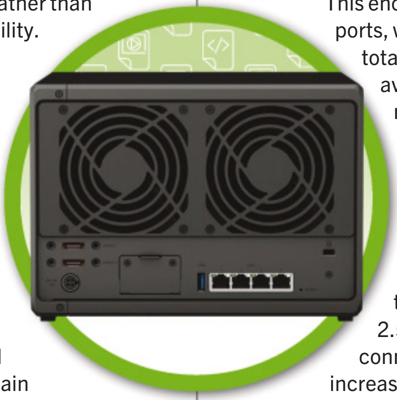
apc
HIGHLY RECOMMENDED
STATUS
DISK 1
DISK 2
DISK 3
DISK 4
DISK 5
DS1522+
Synology

ABOVE **The five bays in the DS1522+ provide lots of flexibility.**

A five-bay NAS, the Synology DiskStation DS1522+ opens up more options and gives more flexibility than a four-bay enclosure. It also has much in common with the other Synology enclosures here, benefitting from a powerful operating system and brilliant apps.

The enclosure has a tool-free design throughout. Hard disk caddies are available from the front of the device, and can be locked into place using the provided plastic key. This simple latching system won't stop a determined thief, but it will stop someone accidentally removing a hard disk while the NAS is running.

Having five bays, rather than four, gives extra flexibility. You can use the extra drive for additional storage space, opting for a single-disk-failure fault tolerance. You can also opt for a system with two-disk redundancy (RAID or via SHR), which means that any two hard disks can fail and your data will remain intact. Alternatively, you can create one three-disk array and one two-disk array, which could be a good way to use up existing hard disks, using two different storage pools for various tasks.



LEFT **Four 1GbE ports expand the available network bandwidth.**

If you need more storage space, there are two eSATA ports at the rear, which give you support for a total of 15 drive bays if you add two DX517 expansion units. That allows you to go from a maximum 80TB of storage with five bays to a staggering 240TB.

With the bays removed, the dual SODIMM memory slots are available. This NAS comes pre-loaded with 8GB of RAM, paired with a dual-core AMD Ryzen R1600 CPU, but you can upgrade to 32GB if you don't mind discarding the pre-installed stick of RAM.

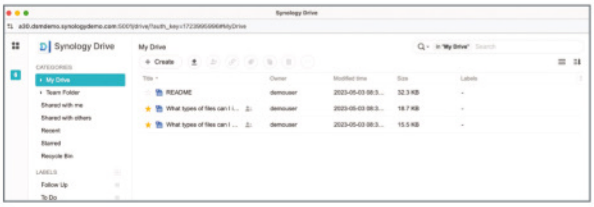
SSD caching is available via the dual M.2 slots. These are accessible without having to take the case apart, so you can install SSDs at the time of installation, or you can hold off and add them at a later date. The only disappointing thing is that you can't use the SSDs as a storage pool; they're a caching option only. And, if you want a read/write cache, you need two SSDs configured as RAID1.

This enclosure has four 1GbE ports, which expands the total network bandwidth available and gives more options if you want to connect the NAS to different subnets. As with the other Synology drives on review, we would have liked these ports to be 2.5GbE, as this kind of connection is increasingly popular and quickly increases the connection speed to the NAS.

If you need a faster connection, you can add a 10GbE port via the upgrade slot at the back. Again, this can be performed without having to take the chassis apart. In terms of assembly and maintenance, Synology is a long way ahead of the competition.

The same can be said of the DSM operating system. It's mature, flexible and supremely powerful. It offers just the right level of handholding to get your system up and running, and the power should you want to take control of how your disks are configured.

BELOW **Synology Drive offers a Dropbox-like experience.**



Title	Owner	Modified time	Size	Labels
README	demouser	2023-05-03 08:3...	32.3 KB	-
What types of files can I i...	demouser	2023-05-03 08:3...	18.7 KB	-
What types of files can I ...	demouser	2023-05-03 08:3...	15.5 KB	-

It's also brilliantly supported, both in terms of Synology's applications and third-party add-ons. There's everything from a Dropbox-like client to security camera surveillance software and a fully featured office suite that operates like Google Drive. The range of supporting mobile and desktop software is again unmatched.

Performance from the DS1522+ is generally very good. The tough ATTO 4KB file transfer test resulted in read and write speeds of 39MB/sec with caching enabled, and only slightly below that without. A combination of five populated disk bays, and the higher than average amount of RAM clearly helped. As the file sizes increased, the DS1522+ started to deliver speeds capped by the gigabit Ethernet ports, resulting in 112MB/sec transfer speeds in the ATTO 2MB file test.

We saw write speeds of 96MB/sec and read speeds of 104MB/sec in our real-world tests. Both are quick, but NAS enclosures with 2.5GbE ports do better. PCMark 10 delivered a strong performance, with an overall score of 311, one of the best we've recorded for a system running with hard disks.

Similar to the other Synology products here, the gigabit Ethernet ports are slightly limiting. That said, having four such ports means that bandwidth can be spread out between multiple clients and subnets.

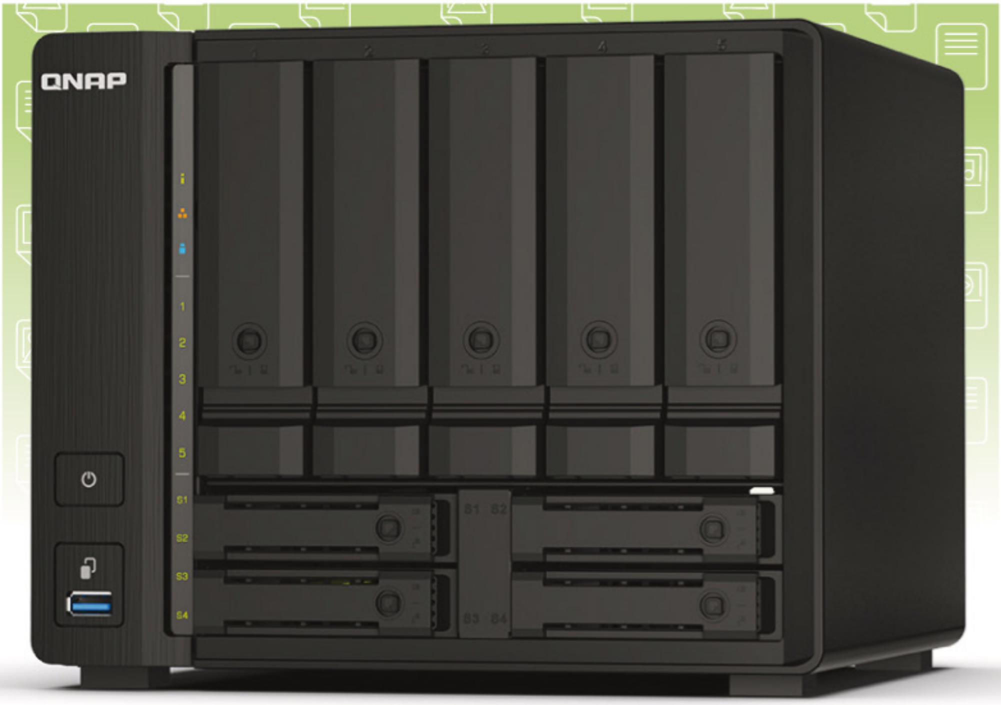
With the base system so good and the expansion options excellent, the Synology DS1522+ remains a top-quality choice for small businesses – particularly those looking to run lots of apps, rather than just having basic networked file storage.

Qnap TS-h973AX

A nine-bay NAS with a mix of 3.5in and 2.5in hard disks and SSDs, but cheaper, more flexible options are available.

★★★★☆

PRICE $1,596
qnap.com



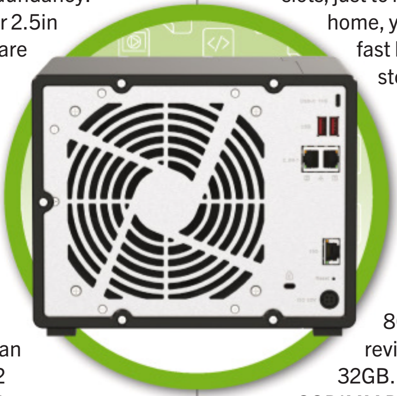
ABOVE **The nine bays in Qnap's TS-h973AX can take a mixture of storage solutions.**

Qnap's TS-h973AX is a nine-bay NAS, but don't imagine that this enclosure can take nine 3.5in hard disks. Instead, those nine bays can take a mixed collection of storage, all accessible from the front via pull-out drive caddies.

The caddies can be locked into place with a simple key lock. This is enough to stop someone from accidentally pulling out a hard disk while the system is running.

Five 3.5in caddies for traditional hard disks sit at the top of the device. This gives good flexibility, as you can either increase the size of a storage pool compared to a four-bay NAS or use the extra slot with RAID6 for two-disk redundancy.

Underneath sit four 2.5in bays. The bottom two are for SATA disks, either laptop-style hard disks or old-fashioned SATA SSDs. The two upper 2.5in drive bays look similar, but as the warning sticker points out, these are for U.2 NVMe drives rather than the more common M.2 NVMe slot. Don't get the two types of 2.5in caddies mixed up: trying to slot a SATA hard disk into a U.2 slot (or vice versa) risks damaging the connectors on both devices.



LEFT **Network ports comprise one 10GbE and two 2.5GbE ports.**

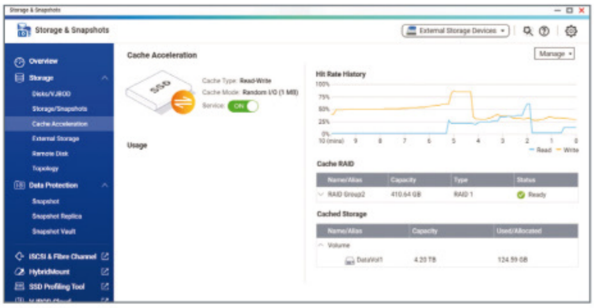
The U.2 format was designed for enterprises. Using a 2.5in form factor allows for higher-capacity SSDs, plus these drives are designed to last longer and have higher reliability – both important factors when you're installing storage in a compact device that's designed to run permanently. If you have spare M.2 drives, you can buy an adapter that fits them in a U.2 slot.

It's good to see the U.2 format in a NAS device, but given the enterprise focus, it would have been nice to see four U.2 slots rather than filling out the TS-h973AX with additional SATA ports. Technically, it should be possible, as the rival Asustor Nimbustor 4 Gen2 AS5404T has four M.2 NVMe sockets inside its case.

With two U.2 slots, high-speed flash-only storage options are limited to a storage pool with both disks (RAID1 being the preferred option) or creating a read/write cache for the hard disks. With four slots, just to hammer the point home, you could have had a fast RAID5 array of storage.

It's a powerful NAS thanks to a quad-core AMD Ryzen Embedded V1500B processor. There are two versions of this product, one with 8GB of RAM (as reviewed) and one with 32GB. You can use the two SODIMM DDR4 slots to upgrade to a maximum of 64GB, which is worthwhile if you're thinking about running a lot of apps .

Three network ports sit at the rear: two 2.5GbE plus one 10GbE, making this the only device on test to come with one. You'll also find a USB-C 3.2 Gen 2 port and a pair of USB-A 3.2 Gen 2 ports (10Gbits/sec), which can be used for adding expansion enclosures.



Cache Acceleration

Cache Type: Read-Write
Cache Mode: Random I/O (1 MB)
Service: ON

Usage

Cache RAID

Name/Alias	Capacity	Type	Status
RAID Group2	410.64 GB	RAID 1	Ready

Cached Storage

Name/Alias	Capacity	Used/Allocated
Volume		
DataVol1	4.20 TB	124.59 GB

BELOW **The QTS operating system is generally easy to use.**

Qnap's QTS operating system is generally easy to use, but as noted elsewhere it can feel techie: setting up storage, it's nice to have the choice between thin and thick provisioning, but there's no simpler automated setup.

With the App Center, you can download and add many extra features, ranging from file synchronisation and backup to media servers and a surveillance centre for security cameras. Compared to Synology, the only obvious omissions are a mail server and an office suite.

Performance with hard disks is generally very good, although we didn't have U.2 drives to test this model with, so only used a five-disk hard disk array. It faced down the tough ATTO 4KB test with 31MB/sec read and write speeds, although we'd expect to see an improvement of a couple of MB/sec with SSD caching.

With larger files, the power of the NAS and its speedy Ethernet ports start to shine. Using a 2.5GbE client, we saw the ATTO 2MB file test return read speeds of 278MB/sec and write speeds of 281MB/sec, putting this NAS close to the top of the table compared to other NAS devices using hard disks or all-flash storage. SSD caching, again, should improve results.

There's a lot to like about the Qnap TS-h973AX. It's fast and powerful, has very fast Ethernet ports and a brilliant operating system. However, four U.2 bays would have added far more flexibility. As it stands, unless you need the benefits of U.2, the four-bay Qnap TS-464 with its two NVMe drive slots is better value, while the Asustor Nimbustor 4 Gen2 AS5404T has more flexibility with four hard disk bays and four NVMe slots.

How we test

As this Labs focuses on home and small office NAS devices, it was important to test them with a realistic setup. We used a Windows 11 desktop PC with an Intel Core i7-12700K processor and 32GB of RAM. This PC has an integrated 2.5GbE port.

For networking tests, we connected the PC and the NAS device to an Eero 7 Max satellite, which has two native 2.5GbE ports and two 10GbE ports. We feel that 10GbE, in the environments we're testing for, is more for backhaul, which is why we stuck with 2.5GbE for testing.

Each NAS was fitted with its maximum number of disks, and Western Digital kindly loaned us 6TB WD Red Pro hard disks for this purpose. We configured the RAID array for the maximum data protection and speed for each device.

For two-bay devices, this meant using RAID1. On four-bay devices, we used RAID5 (or SHR with one redundant disk); with five-bay devices, we used a two-disk-redundancy configuration

Where a NAS had NVMe slots, we added two WD Red 500GB SSDs and repeated our tests with them configured as a read-write cache in a RAID1 array. Where supported, we also configured and tested these as a standalone flash volume, opting for three SSDs in a RAID5 array where more than two slots were available.

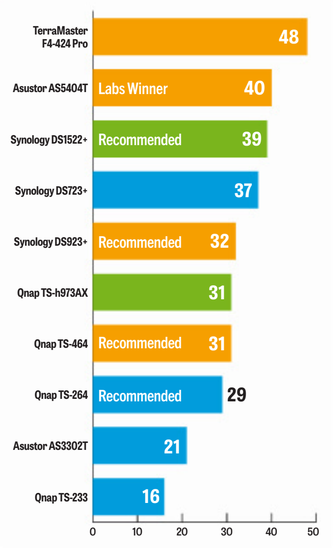
All disks were formatted with Btrfs, and we waited for synchronisation tasks to complete before testing.

We tested transfer speeds with ATTO Disk Benchmark, looking particularly at 4KB, 16KB and 2MB file operations. We also ran the PCMark 10 Data Drive benchmark (supplied here purely for information as we didn't make speed judgements using this).

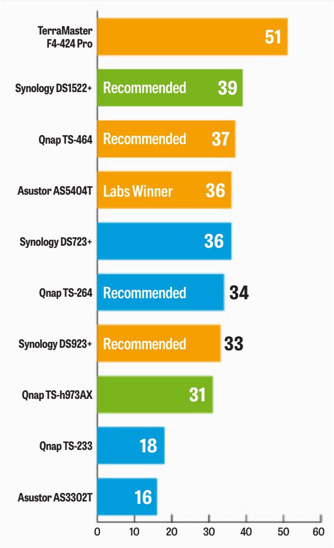
Finally, we tested real-world performance with a 19.3GB folder in Windows 11. This 4,848-file test contained a 9.68GB ISO file, nearly 9GB of photos and almost 1,000 small files averaging 700KB each.

Hard disk tests

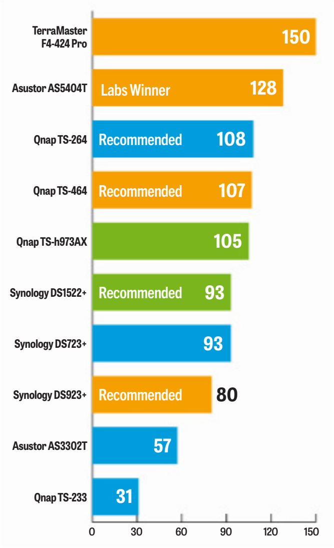
ATTO 4KB reads (MB/sec)



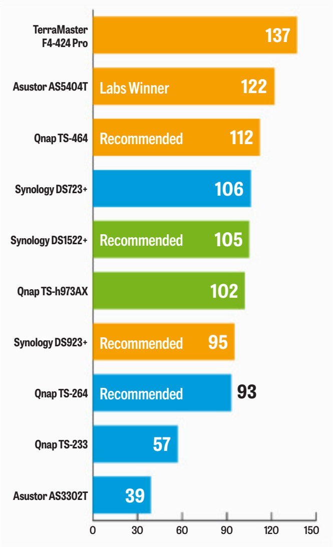
ATTO 4KB writes (MB/sec)



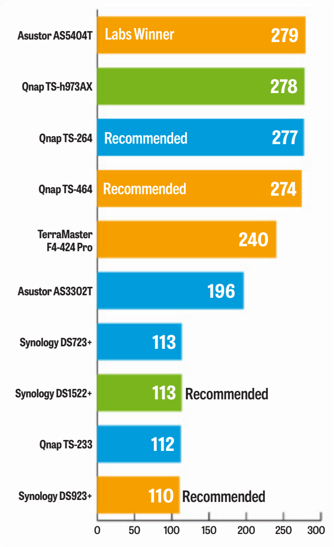
ATTO 16KB reads (MB/sec)



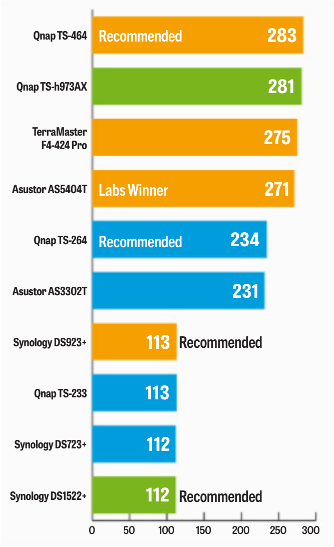
ATTO 16KB writes (MB/sec)



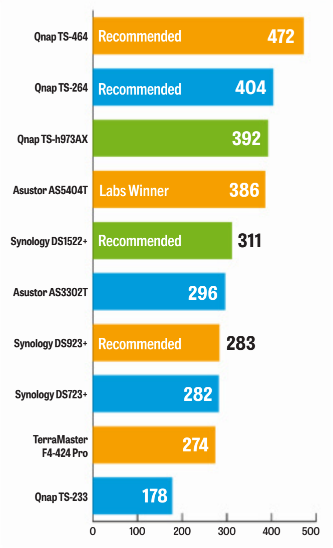
ATTO 2MB reads (MB/sec)



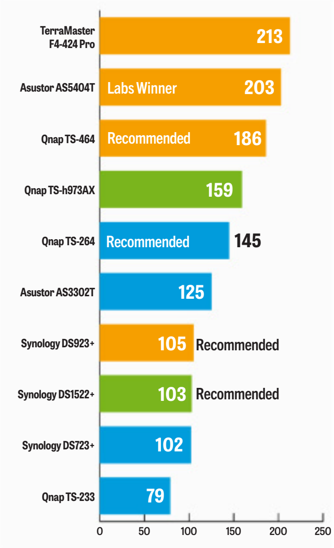
ATTO 2MB writes (MB/sec)



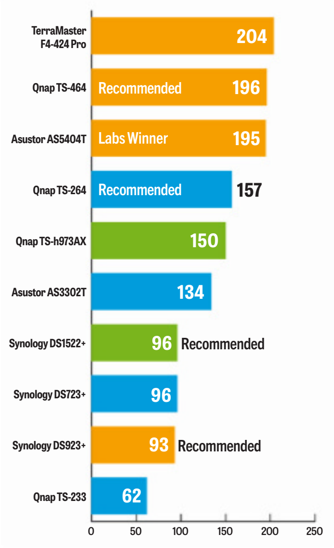
PCMark 10



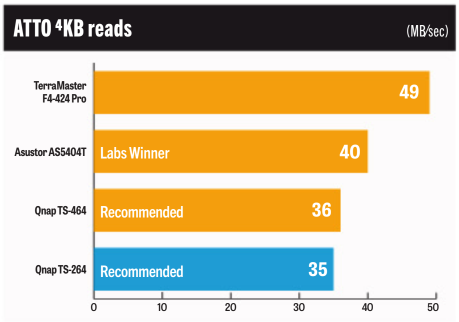
Real-world reads (MB/sec)

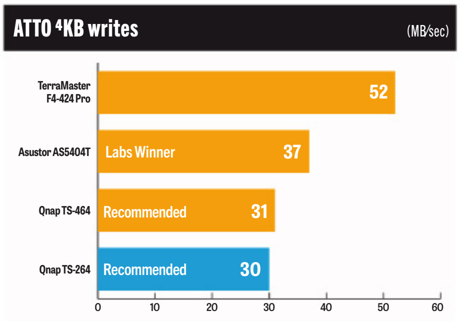


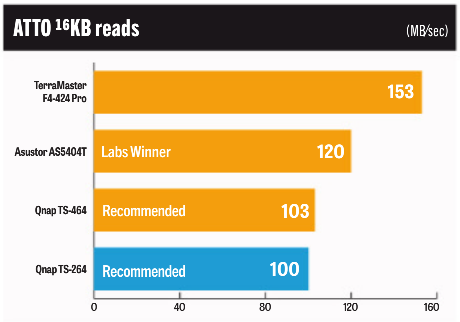
Real-world writes (MB/sec)

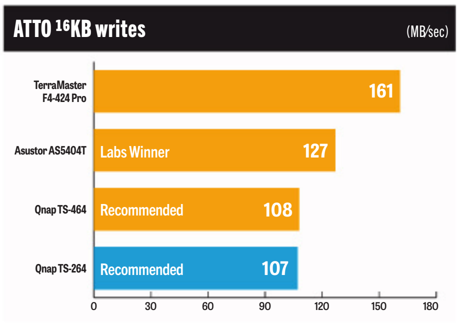


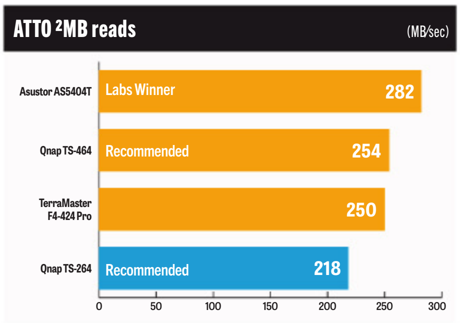
SSD storage tests

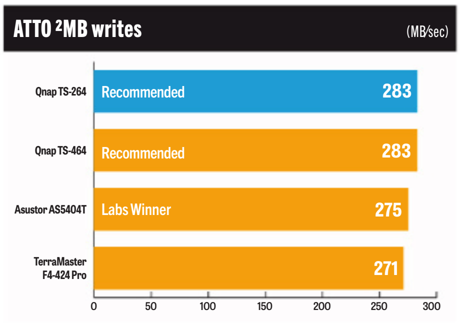

ATTO 4KB reads (MB/sec)

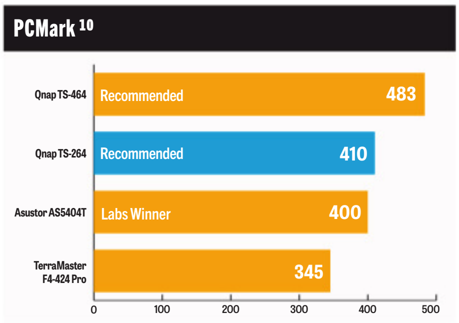

ATTO 4KB writes (MB/sec)

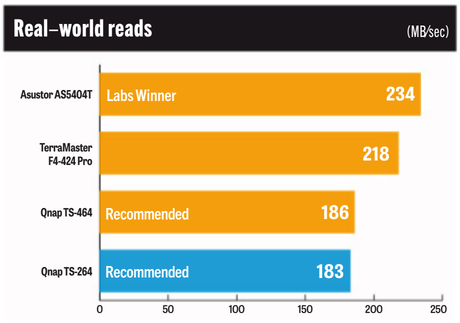

ATTO 16KB reads (MB/sec)

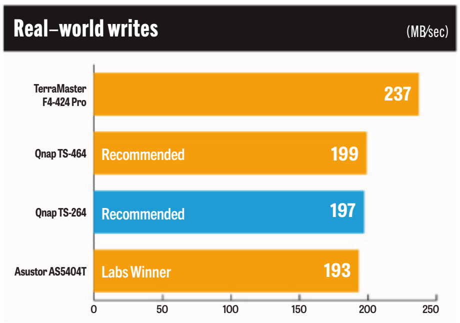

ATTO 16KB writes (MB/sec)


ATTO 2MB reads (MB/sec)


ATTO 2MB writes (MB/sec)


PCMark 10


Real-world reads (MB/sec)


Real-world writes (MB/sec)

View from the Labs

Features and flexibility are important, but you need the network speed to keep up.

When buying a NAS device, it's vital to think about flexibility. Starting with the basics, that means buying the right number of bays for your needs. However, it's also about your ability to use SSD storage in the way that you want. It's becoming increasingly common to see NAS enclosures that let you use SSDs in a storage pool, for fast, quiet storage, not caching alone. That becomes even more important if you can use four NVMe drives instead of two.

David Ludlow is a current fan of NAS drives and a former editor of Computer Shopper.

Layered on top that is the NAS enclosure's operating system and range of apps. Sure, a NAS must provide network-connected storage, but modern devices are fully fledged servers that can provide everything from media streaming and security camera surveillance to Dropbox-style file synchronisation.

Then we come to networking, and in particular whether you need 2.5GbE. You don't need new cables – it easily runs on existing Cat5e cables – while ever more routers, switches and mesh systems have the ports as standard. NAS devices that have two or more gigabit Ethernet ports might offer a similar total bandwidth, but you need more cables and each single client is limited to the slower speed.

What's more, while some NAS devices offer port aggregation, where you can join two 1GbE ports into one fat pipe, the technology isn't well supported on connecting clients. You can argue that 2.5GbE isn't yet common on clients either, but it's easy and cheap to buy a USB adapter.

How much does it matter? With smaller, individual files, you probably won't notice the benefit of 2.5GbE, but the technology still increases the total bandwidth available to clients, and SSD caching helps keep that full bandwidth available for multiple users.

Start dealing with larger project files, however, and 2.5GbE NAS devices can deliver speeds up to 283MB/sec, compared to the 113MB/sec maximum that 1GbE offers. That's a huge difference, making NAS devices with faster Ethernet ports far more attractive than those without. And for those devices, an upgrade to faster Ethernet via an expansion card or USB, if supported, is one of the first things you should consider. ■

Find the best deals
on new gear at
getprice.com/au

The A-List

The best products on the market, as picked by our editors.

Premium laptops

Apple MacBook Pro M4

ONE OF THE BEST LAPTOPS THAT'S EVER BEEN MADE.

This M4 update to the already brilliant MacBook Pro line is an easy recommendation, so the big question becomes do you choose the 14in version or 16in. But whatever you choose should last for years, and look great while it's doing it.

From $2,499, apple.com/au

THE ALTERNATIVES

ASUS ZENBOOK A14
This affordable and super-slim laptop with a 14in OLED panel has all the performance most people need at a very competitive price, and it boasts fantastic build quality.
$1,999, asus.com

APPLE MACBOOK AIR M4
If you don't need the all-out power of the Pro, this is a brilliant, cheaper alternative despite the unchanged chassis and screen.
From $1,699 apple.com/au

MICROSOFT SURFACE LAPTOP 7
A shining example of just how good a Windows laptop can be. Despite a few minor drawbacks, the Surface Laptop is a fantastic package that offers performance and battery life.
$1,899, microsoft.com

Gaming laptops

Alienware m16 R2

A PREMIUM AND AFFORDABLE GAMING & WORK MACHINE.

There are cheaper gaming laptops, and faster ones too, but we love the balance offered by the m16 R2. Who doesn't want a big 16in gaming laptop, featuring a Ultra 9 CPU, a RTX 4070 GPU and 32GB of RAM? And for a decent price, considering it's from Alienware.

$3,300, dell.com

THE ALTERNATIVES

LENOVO LEGION 5I
Best in class performance from the powerful RTX 4070 GPU and stand out features such as 140W PD charging.
$3,499 lenovo.com/au

ACER NITRO V 16
It's a cheap and cheerful gaming laptop, but that's exactly what the Nitro V series does best, and overall this new 16in model offers great bang for buck.
$1,500, store.acer.com

MSI TITAN 18 HX A14V
A wallet-busting powerhouse that pushes the limits of gaming laptops. The MSI Titan 18 HX offers unmatched power and luxury.
$8,599 au.msi.com

Business laptops

HP OmniBook X

THE QUALCOMM CPU REALLY DELIVERS.

The latest Qualcomm CPU helps create a standout laptop that will impress compared to Intel powered alternatives. The OmniBook X has been on sale across all major retailers for $2,079. At this sort of price the X is the cheapest Snapdragon X Elite laptop going, and a compelling buy.

From $2,079, hp.com

THE ALTERNATIVES

DELL PRO 13 PREMIUM
Dell's business laptop series has a new name, but its commitment to build quality and astonishing levels of configuration remain the same.
From $2,536 dell.com/en-au

ASUS ZENBOOK S 16
The Asus Zenbook S 16 offers premium performance in the ultraportable category and competes well with alternatives such as the Surface Laptop 7 or Macbook Pro.
$3,499, asus.com.au

LENOVO YOGA 7I AURA
The Lenovo Yoga Slim 7i Aura is a sleek, versatile laptop with a great display, excellent build quality, and solid performance, and is an especially good buy when on sale.
$2,799, lenovo.com /au

Everyday laptops

Asus Zenbook S 13 OLED

ASUS AND INTEL TEAMED UP TO BUILD A MACBOOK AIR KILLER.

A compact and budget friendly Ultrabook that's the best available device for many on-the-go professionals. Compared to the MacBook Air 13, it has an additional HDMI and USB-A port, an SSD that's roughly twice as fast, and the screen is brighter and offers rich OLED contrast.

$2,099, asus.com

THE ALTERNATIVES

ACER SWIFT 14 AI (INTEL)
The Acer Swift AI 14 is a great overall package, and while the $2,399 RRP feels steep, we've seen it discounted to $1,800, making it an excellent buy.
$2,399, acer.com

APPLE MACBOOK AIR 15
An awesome plus-size MacBook Air with great battery life and graphical performance. GPU performance and battery life are the standout perks here. **From $2,199 apple.com/au**

LENOVO YOGA SLIM 7X
This is almost everything we could want in a Windows laptop, and offers a compelling mix of features, strong performance and amazing battery life.
$2,909, lenovo.com

Chromebooks

Asus Chromebook Plus CX34

A sleek and relatively affordable ChromeOS workhorse, the Asus Chromebook Plus CX34 delivers strong performance and features at a competitive price when on sale, and is ideal for budget-conscious users.

$699, asus.com

Lenovo Flex 3i Chromebook

This isn't the most powerful Chromebook, but students need reliability more than power – especially if they're only really using it for homework, note-taking, and perhaps the occasional bit of Netflix.

$367, lenovo.com/au

Lenovo IdeaPad Duet

The Chromebook answer to Microsoft's Surface tablets, this is a seriously versatile device – albeit not the speediest (although we never found it to be painfully slow while carrying out everyday tasks). For this price, and with a 16hrs 14mins battery life, the Duet is a great choice.

$297, lenovo.com/au

Tablets

Apple iPad Air (M3)

It's hard to be too excited by this update as it's exactly the same design but with an M3 chip inside. But when the original was so damn good, whether in 11in or 13in variants, and Apple Intelligence is thrown in, it remains the best choice for the vast majority of tablet buyers.

From $999, apple.com/au

Apple iPad Pro (M4)

The best tablet in the world becomes even better thanks to Apple's stunning M4 chip, a gorgeous OLED screen and the must-have accessory: the all-new Pencil Pro. But it comes with an obvious downside of cost, with the cheapest 13in incarnation costing $2,199.

From $2,199, apple.com.au

Samsung Galaxy Tab S9 Ultra

This 14.5in tablet offers a size and versatility that even the iPad Pro can't match, with its high price more than justified by the quality of Samsung's AMOLED panel, speakers and productivity software.

$1,999, samsung.com

Everyday monitors

Asus ROG Swift OLED PG32UCDP

We've seen several ultimate gaming monitors in recent months but, from the specs alone, Asus might just have made the most *ultimatest*: 480Hz refresh rate, matte-screen HDR OLED, 32-inch 4K.

$2,399, asus.com.au

BenQ BL2790QT

A 27in, 1440p monitor that's packed with quality, from its brilliant OSD to several clever features designed to fight eye fatigue. Text and images look sharp and punchy, its USB-C docking capability is always welcome, and the speakers are surprisingly decent.

$459, benq.com

LG UltraGear 32

The new LG UltraGear 32GS95UE-B. AAU is not perfect. But it does a pretty comprehensive job of blowing every existing 32-inch 4K gaming monitor based on Samsung's QD-OLED panel tech into last year.

$2,399, msi.com

Professional monitors

Eizo FlexScan EV3240X

With images that whack you between the eyes as soon as you lift it, fully assembled, from its box, this 32in 4K monitor is our top choice pick for anyone willing to make such a hefty long-term investment.

$2,696, eizoglobal.com

Eizo ColorEdge CG2700X

A brilliant choice for professional designers, whether working solo or in teams, thanks to its dedication to providing accurate colours across potentially years of life. It's also bang up to date for connectivity, with USB-C and RJ45 making it easy to manage.

$5,500, eizoglobal.com

Asus ProArt Display PA278CFRV

While it costs too much for casual users, workers and gamers, for professional designers, it's an attractive proposition with easy-to-access, designer-friendly tools and presets.

$629, **asus.com**

Home office printers

HP OfficeJet Pro 9130e

This versatile inkjet all-in-one – which includes a 35-page ADF – pumps out high-quality prints at laser-rivalling speeds. Likewise scans and copies. Print costs are reasonable, too.

$248, hp.com

Canon i-Sensys LBP243dw

Everything you could want from a mono laser printer – it doesn't come with a scanner – the LBP243dw produces excellent results at speed. You also get Wi-Fi and wired networking.

$479, canon.com

Brother MFC-J4540DW

Home workers will love this inkjet all-in-one. It combines an incredible range of features with all the connectivity you need and extreme ease of use. Output quality is fine, it offers the best cloud support around and the high-capacity ink pack could keep you going for years.

$329, brother.com

Find the best deals
on new gear at
getprice.com/au

Wireless routers

Asus RT-BE92U

A premium, consumer-grade Wi-Fi 7 that doesn't cost the Earth. The Asus RT-BE92U doesn't put a foot wrong. It's fast, feature-packed and it even looks good too. At $424 it's also excellent value and is our new Editor's Choice.
$424, rog.asus.com/au

Synology WRX560

Its quad-band Wi-Fi smashed-through our performance tests managing 791.5Mbps up close, 375Mbps two rooms away and an amazing 216.7Mbps down the garden..
$419, synology.com/au

Netgear Nighthawk RS700S

Make no mistake – you won't get stunning speeds out of this Wi-Fi 7 router today. But if you must buy a router now and want future-proofing, this is a solid choice. But honestly, we would recommend that you wait.
$1,499, netgear.com

Mesh Wi-fi

TP-Link Deco XE200

There are cheaper Wi-Fi 6E meshes, but the XE200 wins for its superb download speeds, excellent coverage and the fact that older clients reap benefits of 6E, not just new ones. And a two-pack should be enough for most premises.
$1,299 (2-pack), tp-ink.com

TP-Link Deco X20

The Deco X20 makes it possible to upgrade your home network to Wi-Fi 6 for the price of some standalone routers. The HomeCare functions are also a great bonus for households where lots of devices are fighting over the bandwidth. **$227 (2-pack), tp-link.com**

Asus ZenWiFi AX

The interface and design certainly aren't the prettiest (the charcoal version is straight out of the 1980s), but if you're after strong performance, great features and plenty of expansion potential, the ZenWiFi AX is a compelling prospect.
$939 (2-pack), asus.com/au

NAS servers

Asustor Nimbustor 4 Gen2 AS5404T

A particularly strong choice as a media server, the updated Nimbustor 4 is both flexible and quick. Asustor's Nimbustor 4 AS5404T is a four-drive NAS enclosure aimed at demanding home users or small offices.
$879, asustor.com

NEW Synology DiskStation DS925+

Casual NAS users will find better value elsewhere. However, access to the vast, polished and professional Synology ecosystem will more-than justify the high price to buyers who make use of it.
$1,099, synology.com

NEW Qnap TS-264

The Qnap TS-264 is aimed at those who want a bit more from a traditional two-bay NAS. It's effectively the two-bay version of the excellent four-bay TS-464, and provides strong speeds over its pair of 2.5GbE ports – and includes two M.2 NVMe slots.
$729, qnap.com

Security software

Avast Ultimate

Buy from retail and this is a bargain, with a solid VPN, anti-tracking software and handy detection fees on top of excellent protection.
~$65, 1 device, avast.com/en-au

THE ALTERNATIVES

G DATA TOTAL PROTECTION
Despite its quirks, G Data provides straightforward, effective and inexpensive protection against malware and other threats to your system. **1 device, US$50, avast.com**

AVAST ONE ESSENTIAL
Essential has the same malware-detection engine as our top choice, but for free. It even includes 5GB of VPN services per month and a few system optimisation tools.
Free, avast.com

NordVPN

NordVPN provides consistent and fast speeds, serious security, great support for video-streaming services and some cost-effective subscription rates.
$59 per year, nordvpn.com

THE ALTERNATIVES

PROTONVPN
ProtonVPN provided one of the best free offerings of all the VPNs in our group test, including unlimited data, but upgrade to benefit from even faster speeds and many more options.
Free, protonvpn.com

SURFSHARK
A strong rival to NordVPN, especially if you're willing to commit to its two-year contract. It's fast, cheap and a fine choice for people who like to switch to US streaming services.
$79.61 for one year, surfshark.com

Bitwarden

Bitwarden has a huge advantage: it's free. It isn't as slick as some paid-for rivals, but it can sync passwords across all devices for no extra charge. **Free, bitwarden.com**

THE ALTERNATIVES

DASHLANE
A manager that's ideal for beginners, and it even builds in an unlimited (if basic) VPN service. Note you may prefer to buy the Family plan ($60 per year) as this extends the service to six people.
$55.99 per year (Premium), dashlane.com

1PASSWORD
1Password is targeted at users who are looking for the last word in security. It even offers a Travel Mode that may ease your mind if surrendering your phone to customs officials. **$54.99 per year (individual), 1password.com**

Market Watch

A sampling of PC systems available this month.

SCORPTEC GLITCH RTX 4070

$2,299

tinyurl.com/APC546sco

This whiteout themed system looks well done, ignoring the completely black graphics card which rather detracts from the effect. Coming in the same price as the PC Case Gear system, this has a slightly faster CPU and memory combination, though it has to be said that the 6600MHz RAM is overkill on the Ryzen 7000 series, so a little bit of wasted money there.

Nice RAM, PSU and SSD capacities make for a comfortable system for any task however the RTX 4070 is a generation old now and is a bit of a let down for a new system.

CPU AMD Ryzen 5 7600X; **COOLER** Thermalright Assassin X 120 Refined SE; **MOTHERBOARD** Asus Prime B650M-A WiFi II; **GRAPHICS** Asus Dual Evo GeForce RTX 4070 OC 12GB; **MEMORY** 32GB Team T-Force Delta RGB White 6600MHz DDR5; **STORAGE** 2TB Kingston NV3 M.2 SSD; **POWER SUPPLY** MSI MAG A850GL White 850W; **CASE** Montech Air 100 ARGB White.

PC CASE GEAR HOTLINE 5070

$2,299

tinyurl.com/APC546pcc

Going for the same price as the Scorptec system, this sacrifices a slightly slower CPU and much slower RAM in order to fit in the newest RTX 5070 graphics card. If gaming is your focus this is an easy win where the GPU can offer over 20% more performance than the RTX 4070. Having said that, in CPU bound scenarios, the slow RAM will hinder peak performance output.

The stock CPU cooler and the slightly lower specced PSU are some other sacrifices made to fit the new GPU into the budget. Reasonable compromises in achieving the goal.

CPU AMD Ryzen 5 7600; **COOLER** OEM; **MOTHERBOARD** MSI B650M Gaming WIFI; **GRAPHICS** Zotac Gaming GeForce RTX 5070 Solid OC 12GB; **MEMORY** 16GB Team T-Force Delta RGB 5600MHz CL40 DDR5; **STORAGE** 2TB Team T-Force Z44A7Q M.2 PCIe Gen4 NVMe SSD; **POWER SUPPLY** Kolink 750W PSU; **CASE** Kolink GSI SmartAssembly ARGB.

PLE COMPUTERS SABRE RX 9070 XT

$3,799

tinyurl.com/APC546ple

Sporting an X3D CPU and the latest GPU from AMD, this system screams high refresh rate gaming rig.

The AIO will keep the system cool and quiet, and with 32GB of RAM, 2TB of storage and a 800W PSU there's plenty of capacity and power to feed those processors. The 6000MHz memory is perfect for Ryzen 7000 CPUs, combined with the excess of cooling will make for a very happy CPU.

The RX 9070 XT is capable of 4K gaming with some help from FSR here and there, but ideally it should be used for sub-4K setups to maximise refresh rates. A very capable system that doesn't break the bank.

CPU AMD Ryzen 7 7800X3D; **COOLER** DeepCool LE720 ARGB 360mm AIO; **MOTHERBOARD** Gigabyte B650 Eagle AX; **GRAPHICS** Gigabyte Radeon RX 9070 XT Gaming OC 16GB; **MEMORY** 32GB GeiL Polaris RGB EXPO DDR5-6000 C38; **STORAGE** 2TB Team MP44L PCIe Gen4 NVMe M.2 SSD; **POWER SUPPLY** FSP Hydro PRO 800W; **CASE** DeepCool CH56.

BPCTECH KRAKEN POWER SNOW PIERCER

$3,899

tinyurl.com/APC546bpc

Matching off against the PLE system, this rig focuses more on gamers that prefer quality over raw FPS. The RTX 5080 offers up 20% more graphics horsepower; however, pairing is with a non-X3D version of the Ryzen 7 9700X means it won't hit the crazy high frame rates the PLE system can in competitive titles. If you're all about 4K gaming or running everything with maximum details and ray tracing enabled, this would be the superior system choice.

This does the white theme well with the GPU also in white, and with a Project Zero motherboard, all the cabling is mostly hidden from view, making for a very slick looking system to show off.

CPU AMD Ryzen 7 9700X; **COOLER** Valkyrie A360W 360mm White AIO; **MOTHERBOARD** MSI B650M Project Zero; **GRAPHICS** Gigabyte GeForce RTX 5080 Aero OC SFF 16GB; **MEMORY** 32GB Lexar Thor RGB White 6000MHz CL38 DDR5; **STORAGE** 1TB Klevv Cras C910 PCIe M.2 SSD; **POWER SUPPLY** MSI MAG A850GL White 850W; **CASE** MSI MAG Pano M100R PZ.

YOUR NEXT PC

BLUEPRINTS

Build the best PC for your budget

BUDGET
ADVANCED
MID-RANGE
NZXT

KEY

Budget build

Pick these parts if you want to build a new, well-rounded PC for a good price.

Mid-range build

For productivity power and running every new game at 1080p 60fps. This recommended build will see you through.

Advanced build

You're looking for the best PC on the market and superior components. But you still want to spend smart.

BUDGET BUILD

Enjoy 1080p gaming and most tasks without breaking the bank.

TOTAL

$1,691

MOTHERBOARD		**B660M-HDV** Asrock $139 This is as cheap as we want to go while still offering room for expansion and upgrades down the line.
PROCESSOR		**Core i5 13400F** Intel $225 With ten cores, six of them the Performance kind, this Raptor Lake Core i5 is fantastic value and a great all-rounder.
GRAPHICS CARD		**Radeon RX 7600** AMD $459 AMD delivers what we need for 1080p gaming at a solid price. AMD claims it'll do over 350fps in *Rocket League*, which is a lot.
COOLER		**Laminar RM1 (included with CPU)** Intel Free There's room for an upgrade here, but on a budget the included CPU cooler will work just fine.
MEMORY		**T-Force Vulkan Z 16GB** Teamgroup $59 8 GB of RAM is simply not enough these days, but 16 GB of speedy DDR4 is much more like it.
POWER SUPPLY		**RM650 80 Plus** Corsair $149 A great power supply is a must, and Corsair builds some reliable workhorses. This one's a good balance of price and power.
SSD		**NM790 1TB** Lexar $119 It's time to ditch SATA and go for an NVMe drive, even for a budget PC. You'll appreciate the extra speed and fast boot times.
CASE		**NX200M** Antec $65 This Antec will let your components breathe and has space for further expansion and cooling.
DISPLAY		**Mobiuz EX241** BenQ $270 This BenQ is proof you can buy an excellent 24in 1080p 220Hz gaming monitor for not a huge sum of cash nowadays.
KEYBOARD		**C3 Pro Wired** Keychron $59 It's actually mind blowing what you can pick up for this little cash: a USB mechanical board that looks lovely.
MOUSE		**G305 Lightspeed** Logitech $69 Even on a budget you can still grab a fantastic, ultra-rapid wireless squeaker like this one here.
HEADSET		**HS55 Stereo** Corsair $59 Corsalr's budget wired cans are comfy and have a surprisingly excellent microphone for the money.
MOUSE PAD		**MM100** Corsair $19 A simple black rectangle that can make a world of difference over no-name models, and it's almost as cheap, too.

MID-RANGE BUILD

Our recommended build for solid productivity and playing the latest games.

TOTAL

$2,902

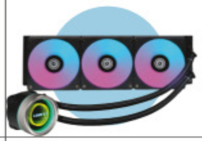
MOTHERBOARD		**TUF Gaming B650-E** Asus $299 A reliable motherboard with plenty of frills, including Wi-Fi 6E, 2.5Gb Ethernet, PCIe 5.0 for the SSD and USB-C on the back.
PROCESSOR		**Ryzen 7 7700X** AMD $529 For the longevity offered by the AM5 socket, we're going for AMD's excellent eight-core Ryzen 7.
GRAPHICS CARD		**RX 7700 XT** AMD $629 If you can spare the extra cash, the RX 7800 XT is a tantalising upgrade. Nevertheless, we'll opt for AMD's cheaper card here.
COOLER		**Peerless Assassin 120 SE** Thermaltake $55 It's a big beast, but it brings cooling performance to the table that's undeniably impressive.
MEMORY		**Delta RGB 16GB 5600MHz** Team T-Force $89 It even has fancy RGB lighting, and this Patriot RAM certainly has the speed you need for less.
POWER SUPPLY		**Pure Power 12 M 750W** Be Quiet! $179 This larger Be Quiet! PSU offers a stable platform with PCIe 5.0 connectivity. At 750W, there's room for a GPU upgrade too.
SSD		**NM790 1TB** Lexar $119 The Lexar proves you can, sometimes, have it all: blazing speeds, cool operation and a great price.
CASE		**H7** Nzxt $179 It's very clever of Nzxt to design such an easy PC case to build into, and make it look so gorgeous too.
DISPLAY		**MPG 275CQRXF** MSI $479 The price of this MSI, considering the 1440p resolution, curve and 240Hz refresh rate, is quite something.
KEYBOARD		**K855 Wireless TKL** Logitech $119 You could spend more for a full-size keyboard, but this mechanical Logitech will certainly suffice for most people.
MOUSE		**DeathAdder V2** Razer $59 This Razer mouse is a superb companion for competitive gaming without breaking the bank.
HEADSET		**Cloud Alpha** HyperX $140 We're still not over the awesome audio quality and excellent comfort of the HyperX Cloud Alpha.
MOUSE PAD		**G440** Logitech $27 This low-friction hard-top mouse pad with minimal branding offers the smoothest of glides for a reasonable price.

ADVANCED BUILD

Go above and beyond with a PC powerful enough to tackle anything.

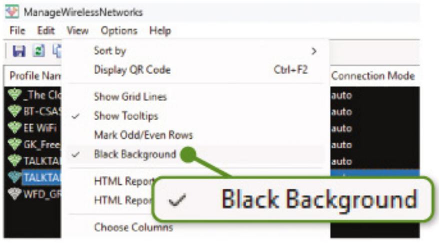
TOTAL

$8,647

MOTHERBOARD		**X870 Eagle WiFi** Gigabyte $419 This fully featured AM5 board comes with great expanadability, and yet is very competitively priced and widely available.
PROCESSOR		**Ryzen 7 9800X3D** AMD $889 The top-tier Zen 5 X3D models will have more cores, but for gaming and most uses this is the bee's knees.
GRAPHICS CARD		**GeForce RTX 5080** Nvidia $2,500 The RTX 5090 is ridiculously expensive, so we're recommending the RTX 5080 instead, but if you can afford a 5090 go for it.
COOLER		**Galahad II Trinity 360** Lian Li $249 Lian Li's Galahad is all about pure liquid cooling performance and it delivers this flawlessly.
MEMORY		**Trident Z5 RGB (2x16GB) 6000MHz** G.Skill $159 This is a new memory standard for a new era of memory speed. DDR5 is blisteringly and fantastically quick.
POWER SUPPLY		**Prime PX-1300** Seasonic $499 This PC is a thirsty beast, so you'd better give it a serious power supply – and this one's similarly monstrous.
BOOT DRIVE		**NM790 4 TB** Lexar $368 With 4TB of storage, it's going to take one seriously big Steam library to get anywhere close to filling this drive up.
MOUSE PAD		**Firefly V2 Pro** Razer $169 Do you need an RGB mouse mat? If it makes you feel any better it's excellent for flick shots.
CASE		**5000D** Corsair $189 We swear this stylish mid-tower is bigger on the inside. It's the PC equivalent of the TARDIS.
DISPLAY		**ROG Swift OLED PG32UCDM** Asus $2,229 You could be much more sensible on your screen than this. For this build, however, we only want the best.
KEYBOARD		**ROG Strix Scope II 96 Wireless** Asus $299 We're keyboard snobs, and we can say with confidence that this full-sized Asus board is about as good as it gets.
MOUSE		**DeathAdder V3 Pro** Razer $179 This is the best gaming mouse in our opinion, made better by an incredibly lightweight frame.
HEADSET		**Maxwell** Audeze $499 Planar magnetic drivers make this headset pure heaven for audio fans. And everyone else, to be honest.

Make Windows better

Expert tips for a better experience.


ManageWirelessNetworks
File Edit View Options Help
Sort by
Display QR Code Ctrl+F2
Show Grid Lines
✓ Show Tooltips
Mark Odd/Even Rows
✓ Black Background
HTML Report
HTML Report
Choose Columns
Profile Nam
_The Cl
BT-CSA
EE WiFi
GK_Free
TALKTA
TALKTA
WFD_GR
Connection Mode
auto
auto
auto
auto
auto
✓ Black Background

WINDOWS 10 & 11

View your Wi-Fi information in dark mode

You can see your saved Wi-Fi networks by opening Windows settings (press Windows key+I) then clicking 'Network & internet' followed by WiFi then 'Manage known networks'. However, you don't see details such as when you logged on, whether the connection was automatic, or what kind of encryption it uses (if any).

You can see this information in Command Prompt, but it's easier to use NirSoft's superb little tool ManageWirelessNetworks. Download it by clicking the purple download link at the bottom of **tinyurl.com/APC546nirsoft**. It's safe to use, so if Microsoft Defender shows a 'Windows protected your PC' warning, click 'More info' then 'Run anyway'.

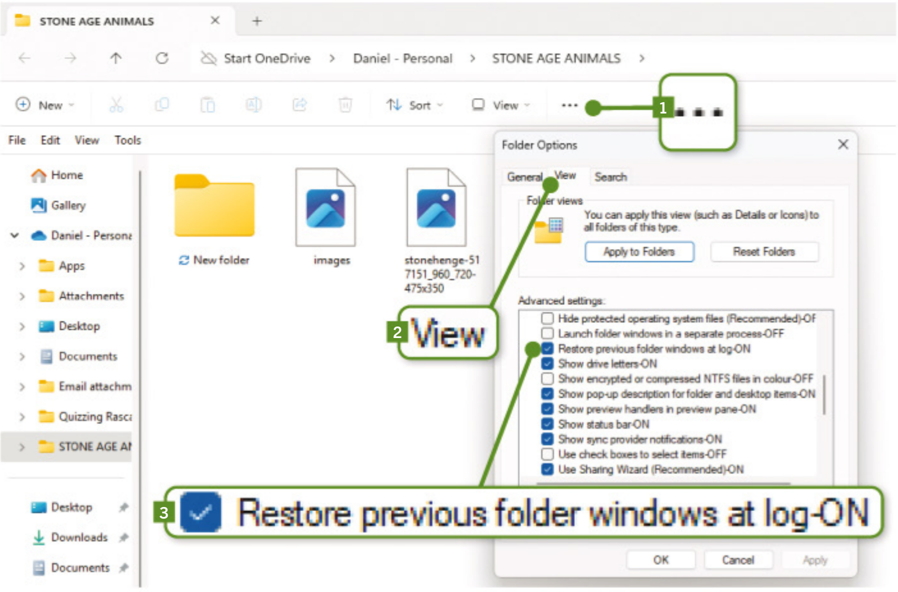
Now click View at the top followed by Black Background (see screenshot below). The background will turn black and the text white. Move the bar at the bottom to see all the information columns the tool shows.

Windows 11

Restore File Explorer tabs when you restart your PC

Microsoft has updated File Explorer so it shows tabs you previously had open when you restart your computer. Open File Explorer then click the menu button (three horizontal dots, 1 in our screenshot) followed by Options. Now click the View tab 2 and tick 'Restore previous folder windows at log-ON' 3. Click OK to confirm.

This option is part of the Windows 11 update KB5050094, and like some others in that update is being rolled out "gradually" to computers. Installing the update takes your computer to build 26100.3037. Check your current build by searching for about in Windows and looking next to 'OS build'.


STONE AGE ANIMALS
Start OneDrive > Daniel - Personal > STONE AGE ANIMALS >
New
Sort
View
...
1
File Edit View Tools
Home
Gallery
Daniel - Persona
Apps
Attachments
Desktop
Documents
Email attachm
Quizzing Rasc
STONE AGE AI
Desktop
Downloads
Documents
New folder
images
stonehenge-51 7151_960_720-475x350
Folder Options
General View Search
Folder views
Apply to Folders
Reset Folders
Advanced settings:
2 View
3
OK
Cancel
Apply

You can apply this view (such as Details or Icons) to all folders of this type.

☐ Hide protected operating system files (Recommended)-OF
☐ Launch folder windows in a separate process-OFF
☑ Restore previous folder windows at log-ON
☑ Show drive letters-ON
☐ Show encrypted or compressed NTFS files in colour-OFF
☑ Show pop-up description for folder and desktop items-ON
☑ Show preview handlers in preview pane-ON
☑ Show status bar-ON
☑ Show sync provider notifications-ON
☐ Use check boxes to select items-OFF
☑ Use Sharing Wizard (Recommended)-ON

☑ Restore previous folder windows at log-ON

WINDOWS 10 & 11

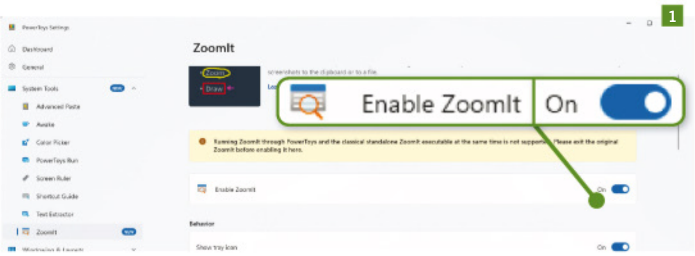
Use sketch pad while presenting

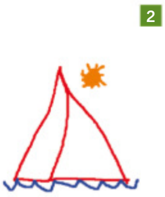
The new PowerToys tool ZoomIt has been very handy for us to zoom and annotate presentations. One advanced tool it has is a full-screen sketch pad, letting you draw in real time. This is handy when you need to go beyond annotations to provide more visual explanations. Whatever you draw on the pad will be seen by your audience.

Launch PowerToys, then click System Tools followed by ZoomIt. Make sure the 'Enable ZoomIt' slider is on (see screenshot 1 below) then scroll down to the Draw section. Read the instructions for using the sketch pad: press Ctrl+W for a white pad, and Ctrl+K for black. Now press Ctrl+1 to start a zoom and try either of these shortcuts.

You can change the screen pen colour to red (Ctrl+R), green (Ctrl+G), blue (Ctrl+B), orange (Ctrl+O), yellow (Ctrl+Y) or pink (Ctrl+P). Change pen thickness by pressing Ctrl+ arrow keys. In our example, we've attempted a rough logo for a new yachting club 2.

Press Ctrl+Z to undo the last drawing. Close the pad by pressing Escape. You'll then need to press Ctrl+1 again to resume zooming and annotating.


1
PowerToys Settings
Dashboard
General
System Tools
Advanced Paste
Awake
Color Picker
PowerToys Run
Screen Ruler
Shortcut Guide
Text Extractor
ZoomIt
ZoomIt
Enable ZoomIt
On
Behavior
Show tray icon
On



WINDOWS 10 & 11

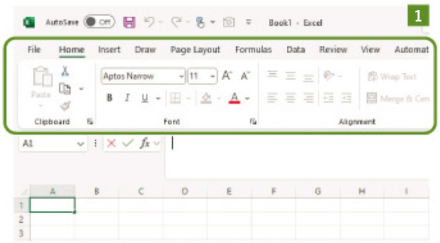
Press down right-shift key to turn on Filter Keys

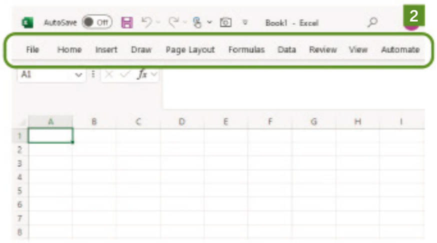
Filter Keys is an accessibility feature that reduces accidental key presses by ignoring repeated or brief keystrokes. It helps users who have difficulties controlling their keyboard, such as people with Parkinson's.

You may know you can turn it on in Windows Settings ('Ease of Access' in Windows 10, Accessibility in 11). But you can also turn it on quickly by pressing down the right Shift key for eight seconds and clicking 'Yes' when prompted. You'll still need to turn it off in Settings. ■

Make Office better

Expert tips for a better experience.


1
AutoSave Off
Book1 - Excel
File
Home
Insert
Draw
Page Layout
Formulas
Data
Review
View
Automat
Aptos Narrow
11
Clipboard
Font
Alignment
Wrap Text
Merge & Cen
A1


2
AutoSave Off
Book1 - Excel
File
Home
Insert
Draw
Page Layout
Formulas
Data
Review
View
Automate
A1

MICROSOFT OFFICE

Collapse ribbon when you make spreadsheet smaller

By default, when you click the top-right 'Restore Down' icon to make your document, presentation or spreadsheet smaller, all the ribbon functions in the tab you've got open remain in view (see screenshot 1). If you find this cluttered, you can collapse the ribbon so you only see the tabs 2. Click File, then Options at the bottom. Now click General on the left and tick 'Collapse the ribbon automatically' 3.

MICROSOFT WORD

Use shortcuts for endnotes, footnotes and index entries

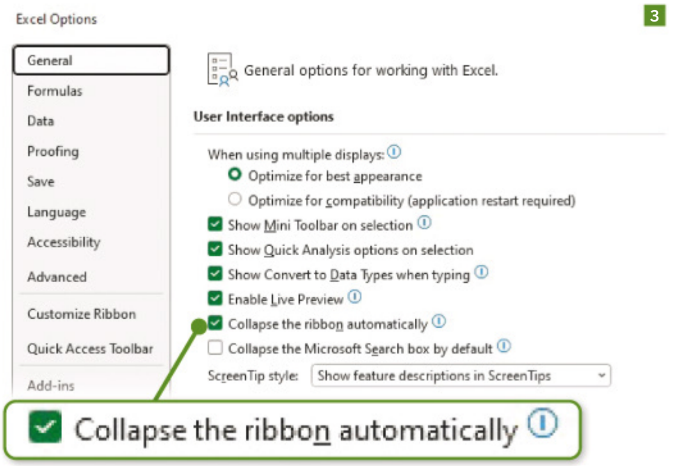
Microsoft Word has several keyboard shortcuts that make it easier to add endnotes and footnotes in documents, and mark an index entry.

For endnotes press Alt+Shift+D; for footnotes press Alt+Shift+F; and for index entries press Alt+Shift+X. You can go to the next footnote by pressing Alt+Shift+Right angle bracket (>), and to the previous by pressing Alt+Shift+Left angle bracket (<).

ONLYOFFICE

Reset crops in right-click menu

OnlyOffice 8.3.0, released in February, adds a 'Reset crop' option to reverse all the crops you've made to an image, taking it back to the original. Once you've cropped an image, you'll see the reset option by right-clicking it (1 in our screenshot below) or in the right-hand panel 2. It works in all of OnlyOffice's tools. ■


Excel Options
3
General
Formulas
Data
Proofing
Save
Language
Accessibility
Advanced
Customize Ribbon
Quick Access Toolbar
Add-ins

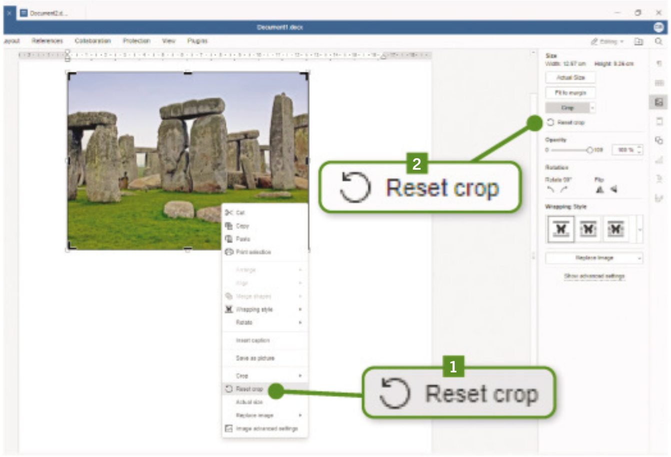
General options for working with Excel.

User Interface options

When using multiple displays:
- ● Optimize for best appearance
- ○ Optimize for compatibility (application restart required)
- ☑ Show Mini Toolbar on selection
- ☑ Show Quick Analysis options on selection
- ☑ Show Convert to Data Types when typing
- ☑ Enable Live Preview
- ☑ Collapse the ribbon automatically
- ☐ Collapse the Microsoft Search box by default

ScreenTip style: Show feature descriptions in ScreenTips

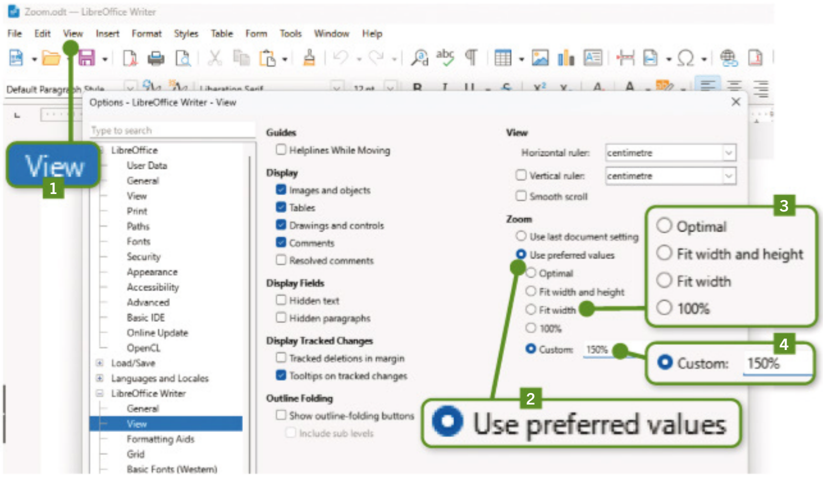
☑ Collapse the ribbon automatically


Document1.docx
2
Reset crop
1
Reset crop

Microsoft Word

Set your preferred zoom level in documents

In previous versions of LibreOffice Writer, if you saved a document when you were zoomed in it would reopen at that same level of zoom. Version 25.2, released in February, gives you the option to override this, so documents will open at the same zoom level every time. Click Tools at the top, then Options at the bottom (or press Alt+F12). Next, click LibreOffice Writer in the menu on the left followed by View (1 in our screenshot). Now select 'Use preferred values' 2 under the Zoom heading and choose the type of zoom you want. LibreOffice gives you four options 3, or you can choose your own zoom level by selecting Custom and typing a percentage 4.


Zoom.odt — LibreOffice Writer
File
Edit
View
Insert
Format
Styles
Table
Form
Tools
Window
Help
Options - LibreOffice Writer - View
Type to search
LibreOffice
User Data
General
View
Print
Paths
Fonts
Security
Appearance
Accessibility
Advanced
Basic IDE
Online Update
OpenCL
Load/Save
Languages and Locales
LibreOffice Writer
General
View
Formatting Aids
Grid
Basic Fonts (Western)
View
1
2
3
4

Guides
- ☐ Helplines While Moving

Display
- ☑ Images and objects
- ☑ Tables
- ☑ Drawings and controls
- ☑ Comments
- ☐ Resolved comments

Display Fields
- ☐ Hidden text
- ☐ Hidden paragraphs

Display Tracked Changes
- ☐ Tracked deletions in margin
- ☑ Tooltips on tracked changes

Outline Folding
- ☐ Show outline-folding buttons
- ☐ Include sub levels

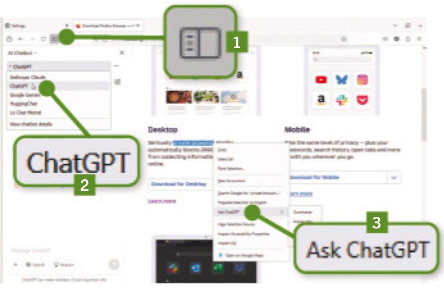
View
- Horizontal ruler: centimetre
- ☐ Vertical ruler: centimetre
- ☐ Smooth scroll

Zoom
- ○ Use last document setting
- ● Use preferred values
  - ○ Optimal
  - ○ Fit width and height
  - ○ Fit width
  - ○ 100%
  - ● Custom: 150%

○ Optimal
○ Fit width and height
○ Fit width
○ 100%
● Custom: 150%
● Use preferred values

Browser tips

Secret settings and best extensions


1
ChatGPT
2
Ask ChatGPT
3
Desktop
Mobile

BRAVE

Discover the best new features in Brave

It's been a while since Brave had a significant update, but version 175.178 brings a host of welcome changes to the privacy-focused browser.

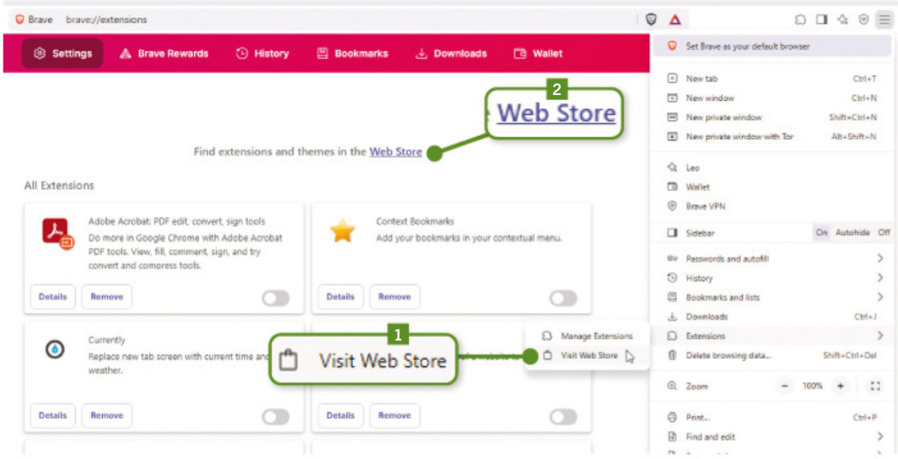
It's now easier to access the Chrome Web Store so you can install Chromium extensions in Brave – which some users don't realise is possible. A 'Visit Web Store' option has been added to the Extensions section of the main menu (1 in our screenshot below), and the Extensions page (**brave://extensions**) now has a direct link to the Chrome Web Store 2.

Brave has also introduced a quicker way to take screenshots of web pages. Previously, you needed to click the Share button in the address bar and choose Screenshot. You can now simply press Ctrl+Shift+S and then select the area you want to capture.

The vertical-tabs feature (which you activate by going to Settings, Appearance, then Tabs and switching on 'Use vertical tabs') has a new right-click menu. This lets you right-click an empty area of the vertical-tabs bar to access options including 'New tab', 'Reopen closed tabs' and 'Bookmark all tabs'.

Interestingly, Brave has removed one of its most noteworthy features – the ability to block all cookies on all websites. This was apparently 'breaking the web' for some users, so you're now limited to blocking third-party cookies by default.

See our Workshop below to learn how to either restore the option or block all cookies for specific sites instead.


Brave brave://extensions
Settings
Brave Rewards
History
Bookmarks
Downloads
Wallet
2
Web Store
1
Visit Web Store
Set Brave as your default browser
New tab Ctrl+T
New window Ctrl+N
New private window Shift+Ctrl+N
New private window with Tor Alt+Shift+N
Leo
Wallet
Brave VPN
Sidebar On Autohide Off
Passwords and autofill
History
Bookmarks and lists
Downloads Ctrl+J
Extensions
Manage Extensions
Visit Web Store
Delete browsing data... Shift+Ctrl+Del
Zoom 100%
Print... Ctrl+P
Find and edit
Details
Remove

Find extensions and themes in the Web Store

All Extensions

Adobe Acrobat: PDF edit, convert, sign tools
Do more in Google Chrome with Adobe Acrobat PDF tools. View, fill, comment, sign, and try convert and compress tools.

Context Bookmarks
Add your bookmarks in your contextual menu.

Currently
Replace new tab screen with current time and weather.

FIREFOX

Talk to ChatGPT while you browse the web

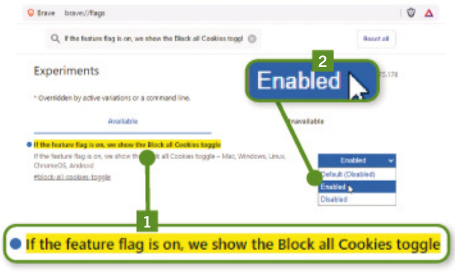
For a few months now, Firefox has let you access ChatGPT through its experimental 'AI chatbot' feature. As of Firefox 136 (released 4 March), the feature is officially integrated with the browser, so you no longer need to enable it in Firefox Labs.

Just click the 'Show sidebars' button on the toolbar (to the right of the Reload button – 1 in our screenshot above) to open a sidebar on the left-hand side of the browser. Click the dropdown menu at the top and choose AI Chatbot – or press the keyboard shortcut Ctrl+Alt+X.

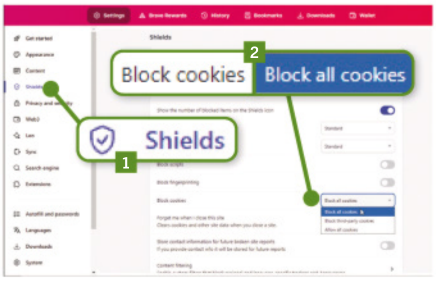
ChatGPT should now load in the sidebar, though you may get another supported AI assistant such as Google Gemini or Anthropic Claude. If so, click the list of chatbots and select ChatGPT 2.

You can now talk to ChatGPT as you browse the web and ask it questions about the content you're viewing. Now you no longer need to sign into an OpenAI account to use ChatGPT's

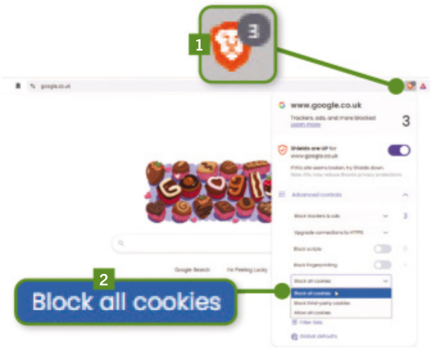
Workshop Block all cookies on all websites in Brave


Brave brave://flags
Experiments
Reset all
2
Enabled
Available
Default (Disabled)
Enabled
Disabled
1
If the feature flag is on, we show the Block all Cookies toggle

To restore Brave's 'Block all cookies' option, type brave://flags in the address bar and press Enter to load the Experiments page. Find the entry If the feature flag is on, we show the Block all Cookies toggle 1 and select Enabled in its dropdown menu 2


Block cookies
Block all cookies
2
Shields
1

Click 'Relaunch' to restart the browser. When Brave reopens, click the three-line menu button and choose Settings. Select 'Shields' 1 and click the dropdown menu next to 'Block cookies'. The 'Block all cookies' option 2 will now have been restored.


1
3
www.google.co.uk
2
Block all cookies

Because blocking all cookies stops some sites working, it's wiser to block them on specific sites instead. Click the Shields (lion) button on the toolbar 1 and open 'Advanced controls'. Select 'Block all cookies' 2 to do so only on the current site.

Best extension for… Switching to incognito mode

OPEN INCOGNITO TAB

Chromium

tinyurl.com/APC546incog

To view a web page in incognito mode in Chrome and other Chromium browsers, you can right-click a link to it and choose ‘Open link in incognito window’. But your browser doesn’t offer a quick way to switch the page you’re currently viewing to private-browsing mode – instead you need to open an incognito window and type or paste the page’s URL. ‘Open incognito tab’ makes it much easier to open the current page in incognito mode. You can either click its toolbar button (see screenshot); right-click the page and choose ‘Open this tab in incognito’; or use the keyboard shortcut Alt+I. Go into the extension’s Options to specify whether to close the current tab after it’s been transferred to private mode, and to remove it from your browsing history.

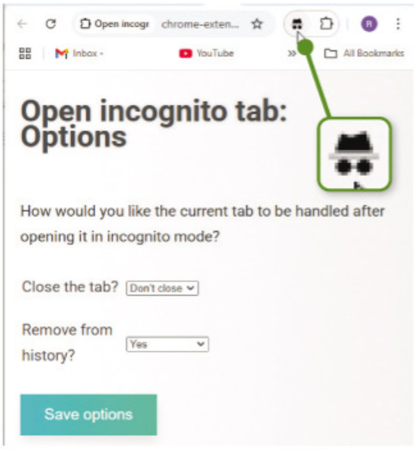
If you don’t like that, try…

OPEN IN PRIVATE MODE

Firefox

tinyurl.com/APC546ffincog

This extension brings the same functionality to Firefox, provided you grant it permission to run in the browser’s private mode.



Open incognito tab: Options

How would you like the current tab to be handled after opening it in incognito mode?

Close the tab? Don't close

Remove from history? Yes

---

web-search option, but doing so unlocks more responses and features such as file uploads, chat history and voice mode.

If you’d prefer the ChatGPT sidebar to be on the right-hand side of the browser, click the dropdown menu at the top and choose ‘Move Sidebar to Right’. You can also interact with the chatbot by right-clicking text content on a web page and choosing Ask ChatGPT 3. Options include Summarise, ‘Explain this’ and ‘Quiz me’.

EDGE

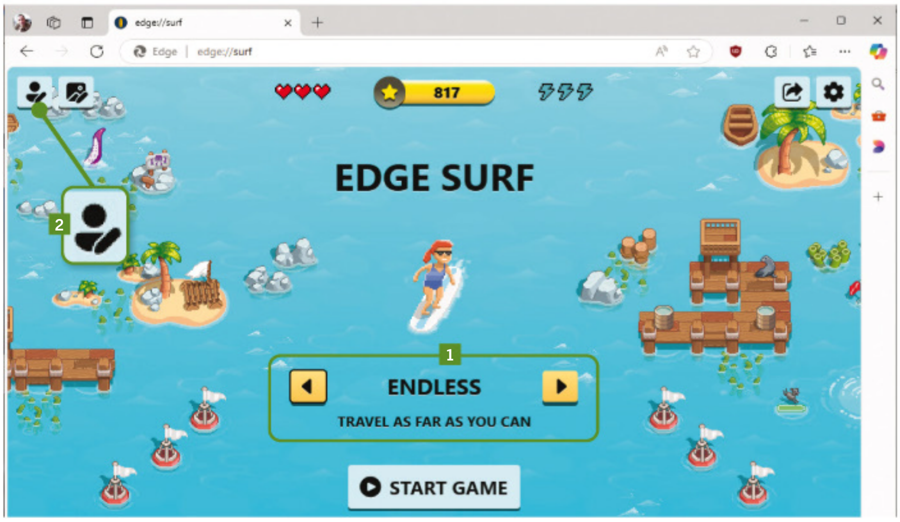
Play the enhanced version of the Surf game

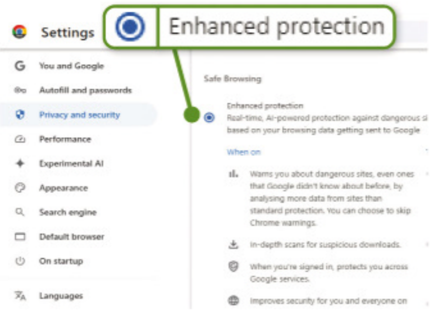
While Chrome has its built-in Dinosaur Game (also known as Chrome Dino, **en.wikipedia.org/wiki/Dinosaur_Game**), Edge has its own timewaster called Surf (**en.wikipedia.org/wiki/Surf_(video_game)**). This game loads when you go offline and when you type **edge//surf** in the browser’s address bar, and involves guiding a surfer across a body of water, avoiding obstacles and collecting power-ups.

Microsoft has now revamped the Surf game, with higher-quality graphics that “retain the spirit of the original theme while levelling things up significantly”. In addition to the three existing game modes – Endless, Time Trial and Zigzag – there’s a new Collector mode, which challenges you to collect as many coins as you can while you surf.

Switch between these modes by clicking the left and right arrows on the Surf home screen (1 in our screenshot). To revert to the old Surf game, click the ‘Edit theme’ button in the top-left corner and select Surf Classic.

A new High Score bar measures your current progress against your previous best, and you can now customise the appearance of your surfer character. Click the ‘Edit player’ button top left 2 and choose your preferred outfit, hairstyle, skin tone and accessories. As before, you can control your surfer using your mouse or the cursor keys on your keyboard. Watch out for the deadly kraken!





Enhanced protection

Real-time, AI-powered protection against dangerous si… based on your browsing data getting sent to Google

Warns you about dangerous sites, even ones that Google didn't know about before, by analysing more data from sites than standard protection. You can choose to skip Chrome warnings.

In-depth scans for suspicious downloads.

When you're signed in, protects you across Google services.

Improves security for you and everyone on

CHROME

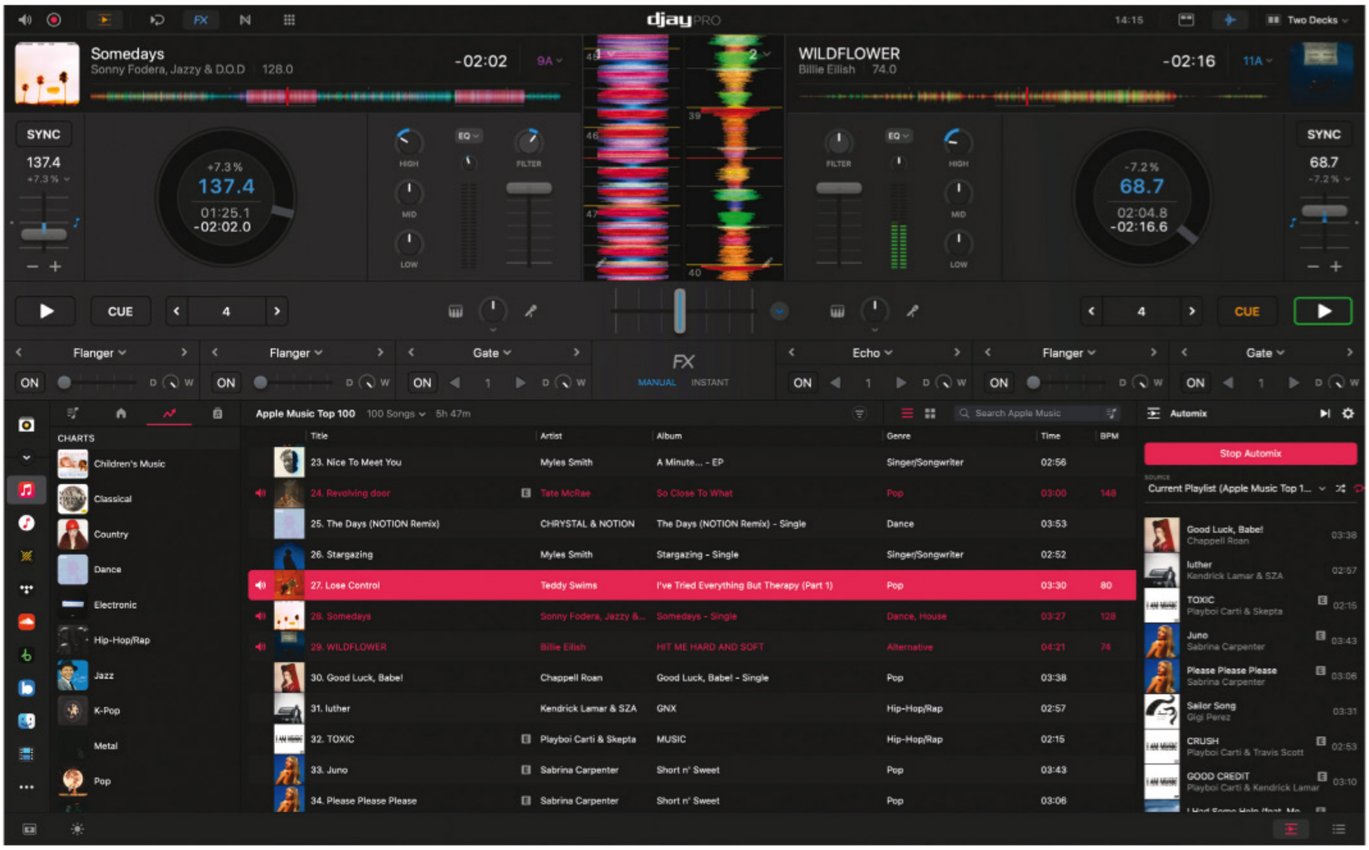
Get AI-powered protection against risky sites

Google has bolstered Chrome’s ‘Enhanced protection’ security feature with new AI capabilities. It claims the option now provides “real-time, AI-powered protection against dangerous sites, downloads and extensions”.

This means ‘Enhanced protection’ will be better able to detect and block new threats as you browse the web, in addition to those previously identified by Google. Chrome will also now perform deeper scans of files before you download them, and offer stronger protection across all the Google services you’re signed into with your account.

To activate ‘Enhanced protection’, click Chrome’s three-dot menu button then choose Settings followed by ‘Privacy and security’. Click ‘Security’ and select ‘Enhanced protection’ in the Safe Browsing section (see screenshot above).

Note that the feature sends the URLs of sites you visit and a small sample of page content, downloads, extension activity and system information to Google to check if they’re harmful. ■



Apple Music Top 100 100 Songs 5h 47m

Title	Artist	Album	Genre	Time	BPM
23. Nice To Meet You	Myles Smith	A Minute... - EP	Singer/Songwriter	02:56	
24. Revolving door	Tate McRae	So Close To What	Pop	03:00	148
25. The Days (NOTION Remix)	CHRYSTAL & NOTION	The Days (NOTION Remix) - Single	Dance	03:53	
26. Stargazing	Myles Smith	Stargazing - Single	Singer/Songwriter	02:52	
27. Lose Control	Teddy Swims	I've Tried Everything But Therapy (Part 1)	Pop	03:30	80
28. Somedays	Sonny Fodera, Jazzy &...	Somedays - Single	Dance, House	03:27	128
29. WILDFLOWER	Billie Eilish	HIT ME HARD AND SOFT	Alternative	04:21	74
30. Good Luck, Babe!	Chappell Roan	Good Luck, Babe! - Single	Pop	03:38	
31. luther	Kendrick Lamar & SZA	GNX	Hip-Hop/Rap	02:57	
32. TOXIC	Playboi Carti & Skepta	MUSIC	Hip-Hop/Rap	02:15	
33. Juno	Sabrina Carpenter	Short n' Sweet	Pop	03:43	
34. Please Please Please	Sabrina Carpenter	Short n' Sweet	Pop	03:06	

Mix music on your Mac

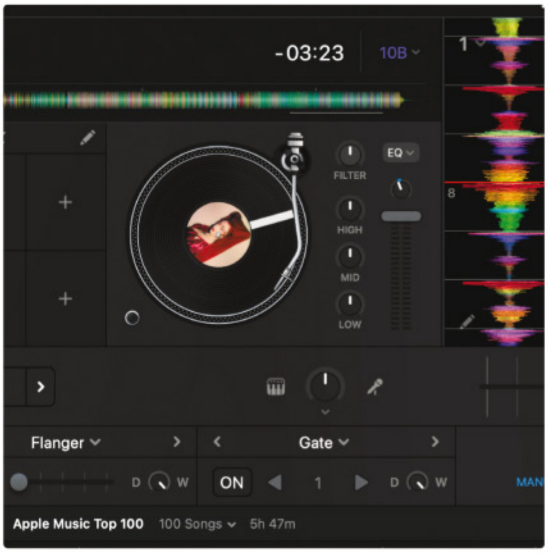
Mix tracks like an absolute boss with advanced features in djay Pro

IT WILL TAKE
20 minutes
YOU WILL LEARN
How to load and mix music tracks
YOU'LL NEED
djay Pro (**$79.99, algoriddim.com**), macOS 15 or later, Apple Music or similar subscription or local music files

GENIUS TIP!
Most tools and functions have a keyboard shortcut – get to know the ones you use most and it can be a faster way to navigate.

djay Pro for Mac isn't just a fun way to perform with music, it actually won an Apple Design Award in 2024. Although it's easy to use it has lots of powerful pro features, starting with its ability to hook into all the major streaming services from Apple Music and Spotify to Tidal, SoundCloud and more. And if you have a collection of MP3s on your Mac it can work with those too.

At the heart of djay Pro is its ability to automatically analyse any track and determine its tempo then let you sync it to any other track with just one click, crossfading between the two using a classic fader or with a choice of dynamic transitions like echoes or sweeps. There's also a choice of cool effects you can drop into any playback to liven things up.



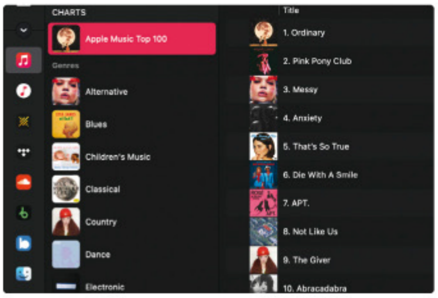
In the Vinyl deck view, you can pick up a virtual needle arm and drop it on a virtual platter to scroll through a track.

Mix it up

Since artificial intelligence (AI) is all the rage, djay Pro uses advanced analysis to power its Automix feature which can identify tracks with similar characteristics and compatible intros and outros, then when activated, play back a continuous mix without any input from you, complete with transitions. There's even support for 4K video playback and hardware DJ controllers if you want to take things even further. Here we'll explore how to set up Apple Music and get busy performing and creating seamless mixes in just a few steps, and see how the intelligent AI-powered Automix can make your life even easier.

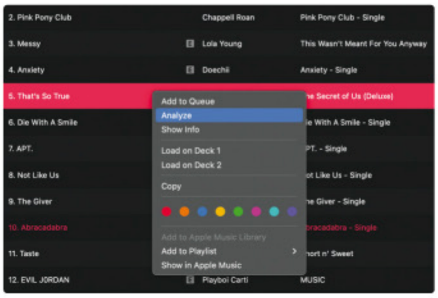
Hollin Jones ■

How to Mix music tracks like a pro


CHARTS
Apple Music Top 100
Genres
Alternative
Blues
Children's Music
Classical
Country
Dance
Electronic
Title
1. Ordinary
2. Pink Pony Club
3. Messy
4. Anxiety
5. That's So True
6. Die With A Smile
7. APT.
8. Not Like Us
9. The Giver
10. Abracadabra

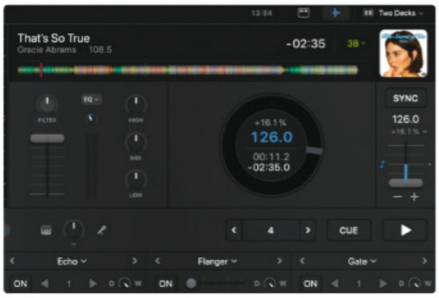
1 Link your accounts

At the bottom left of the app window, you'll find a list of services and locations for loading music. Sign in to the services you use – here we have chosen Apple Music but you can mix and match any of them, including local files.


2. Pink Pony Club
Chappell Roan
Pink Pony Club - Single
3. Messy
Lola Young
This Wasn't Meant For You Anyway
4. Anxiety
Doechii
Anxiety - Single
5. That's So True
6. Die With A Smile
7. APT.
8. Not Like Us
9. The Giver
10. Abracadabra
11. Taste
12. EVIL JORDAN
Playboi Carti
MUSIC
Add to Queue
Analyze
Show Info
Load on Deck 1
Load on Deck 2
Copy
Add to Apple Music Library
Add to Playlist
Show in Apple Music

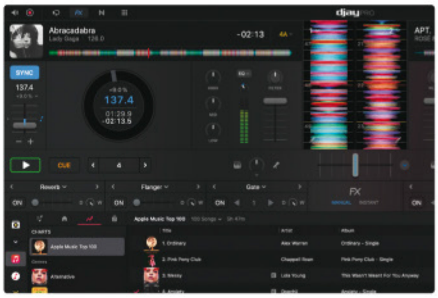
2 Analyse your track

Choose a playlist and from it, a track to play back. Djay will analyse any track you drag and drop into one of the two decks, but you can also Ctrl-click any track and select Analyze to pre-scan it and view its BPM in the playlist.


That's So True
Gracie Abrams 108.5
-02:35
3B
SYNC
126.0
126.0
CUE
Echo
Flanger
Gate
ON

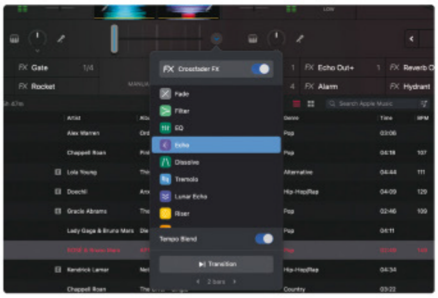
3 Sync tempos together

Drag a track into deck 1 then move the crossfader in the centre all the way to the left, so only that deck will be heard. Then drag a new track to deck 2 and click its SYNC button, which will synchronise its tempo to the track in deck 1.


Abracadabra
Lady Gaga
-02:13
4A
SYNC
137.4
CUE
Reverb
Flanger
Gate
FX
ON
Apple Music Top 100

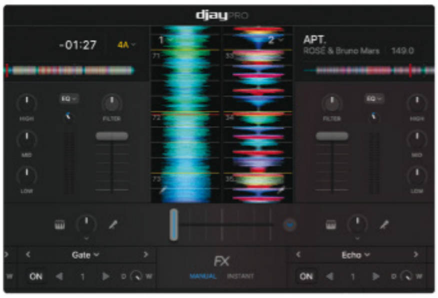
4 Crossfade tracks

Slowly move the crossfader towards its centre position to adjust both tracks' tempos dynamically so they transition smoothly. You can also use the small tempo faders at the sides (under SYNC) to manually change their speeds.


FX Gate
FX Rocket
FX Crossfader FX
Fade
Filter
EQ
Echo
Dissolve
Tremolo
Lunar Echo
Riser
Tempo Blend
Transition
FX Echo Out
FX Alarm
FX Reverb
FX Hydrant

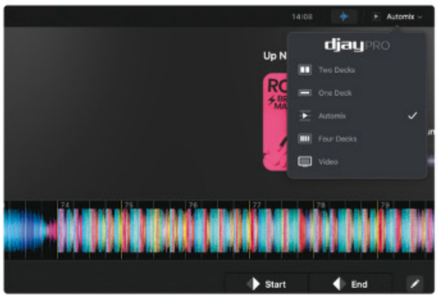
5 Create transition effects

Click the small down arrow by the crossfader to use more varied crossfade effects. You can add things like echoes or phasing during the fade between tracks. Use the Transition button to have the app smoothly crossfade for you.


djay PRO
-01:27
4A
APT.
ROSÉ & Bruno Mars
149.0
Gate
Echo
FX
MANUAL
INSTANT
ON

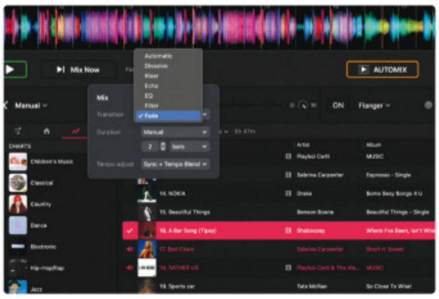
6 Use live effects

From the FX area under each deck, choose from various effects to turn on or off, with a variable slider. Or switch from Manual to Instant mode to make effects punch in and out when you select them, for a different vibe.


Automix
djay PRO
Two Decks
One Deck
Automix
Four Decks
Video
Start
End

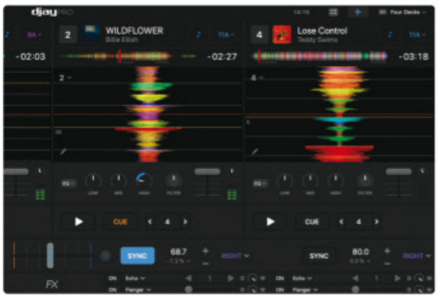
7 Use AI to automix

From the Mode menu at the top right corner, select Automix. Now when you play a track, djay will automatically crossfade and transition the tempo smoothly to the next track in the playlist without you needing to do anything.


Mix Now
AUTOMIX
Manual
Automatic
Dissolve
Riser
Echo
EQ
Filter
Fade
Flanger
ON

8 Automix a playlist

Click the Automix button and djay will automatically mix your entire playlist for you, leaving you free to enjoy the party. Click the Fade pull-down menu here to choose more dynamic transition effects to spice thing up.


djay PRO
WILDFLOWER
Billie Eilish
Lose Control
Teddy Swims
-02:03
-02:27
-03:18
CUE
SYNC
FX

9 Go pro with four decks

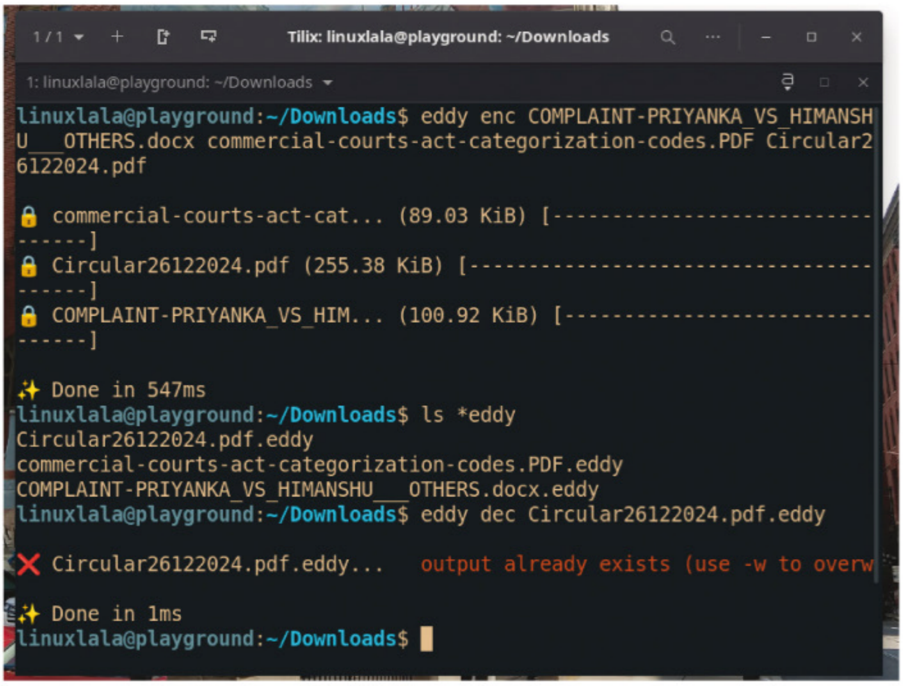
To go further, select the four-deck option from the top-right menu (four-square icon). This offers the same tools but with four decks, meaning you can sync and fade between four different tracks without needing to reload decks. ■

Eddy encryption tool

Keeping files safe from prying eyes doesn't need to be a Herculean trial. Shashank Sharma knows of a utility that makes it a breeze.

With great power may very well come great responsibility. But with a repository of important files, there definitely comes a need for security. Depending on the nature of the files, of course. While one might certainly feel the need to safeguard the toddler's attempts at drawing a green-coloured snowman, you needn't necessarily encrypt such musings. On the other hand, if you do have files that need to be encrypted for safekeeping, *Eddy* is a useful little utility with no learning curve.

A quarter way into the 21st century, computer tools and apps shouldn't require users to jump through hoops, or master new concepts and technologies to take advantage of them. One area where this is often lacking is encryption, because while there are tools you can use easily enough, they still inundate users with too much information that overwhelms them. Thankfully, Eddy isn't one of them. Released under the MIT licence, Eddy is a CLI file encryption tool that can be used to quickly encrypt and decrypt files. It also features a passphrase generator that you can use for stronger encryption. Should an encrypted file become corrupt or damaged, the tool offers the option to force-decrypt the contents. Eddy also stands out from other tools for its reliance on ChaCha20 256-bit cipher instead of the more widely used AES-256 algorithm.


1 / 1
Tilix: linuxlala@playground: ~/Downloads
1: linuxlala@playground: ~/Downloads

```
linuxlala@playground:~/Downloads$ eddy enc COMPLAINT-PRIYANKA_VS_HIMANSH
U___OTHERS.docx commercial-courts-act-categorization-codes.PDF Circular2
6122024.pdf

🔒 commercial-courts-act-cat... (89.03 KiB) [--------------------------
------]
🔒 Circular26122024.pdf (255.38 KiB) [----------------------------------
------]
🔒 COMPLAINT-PRIYANKA_VS_HIM... (100.92 KiB) [-------------------------
------]

✨ Done in 547ms
linuxlala@playground:~/Downloads$ ls *eddy
Circular26122024.pdf.eddy
commercial-courts-act-categorization-codes.PDF.eddy
COMPLAINT-PRIYANKA_VS_HIMANSHU___OTHERS.docx.eddy
linuxlala@playground:~/Downloads$ eddy dec Circular26122024.pdf.eddy

❌ Circular26122024.pdf.eddy...   output already exists (use -w to overw

✨ Done in 1ms
linuxlala@playground:~/Downloads$ █
```

When you attempt to open any EDDY file, the file manager reports an error saying unknown file type.

If you already have Go installed on your Linux distro, run the `go install github.com/70sh1/eddy@latest` command to install it. Although you can install Go from your distro's software repository, it's better to install the official latest version. Head over to the project's website and grab the latest tarball (https://go.dev/dl/). Run the `sudo tar -C /usr/local -xzf go1.24.1.linux-amd64.tar.gz` command to extract the file in the /usr/local directory. You next need to add /usr/local/go/bin to your $PATH, so open the ~/.profile or the ~/.bashrc file in your favourite text editor and add the following line:

`export PATH=$PATH:/usr/local/go/bin`

Save the file then run `source <filename>`. For instance, if you added the export line to the ~/.bashrc file, run the `source ~/.bashrc` command. Go is now available for use, so you can install Eddy with the `go install github.com/70sh1/eddy@latest` command.

If you think this is too much effort to try a new tool, you can use the prebuilt binary offered by the project. Grab the latest tarball from the project's GitHub page (version 1.4.2 at the time of writing), and unpack the tarball with the `tar xvf eddy-v1.4.2-linux-amd64.tar.gz` command. You can now move the

NAVIGATING FROM THE CLI

We've spent plenty of time talking about various text-based file managers over the years. As useful as these are for directory navigation, we have a different type of navigation in mind. The kind that requires maps and stars.

Starfetch is a nifty little tool that you can use to look up different constellations from the comfort of your terminal emulator. You can use `pip` to install the Python package. The `starfetch -l` command can then be used for a list of all constellations. The `starfetch -r` command displays information about a random constellation, or you can specify the name of the constellation you're curious about with the `starfetch -n <constellation>` command.

For even more fun, run the `telnet mapscii.me` command to access the entire world from your terminal. You can use the arrow keys to navigate and the `a` and `z` keys to zoom in or out. You can also use the mouse scroll wheel to zoom in, and drag the map to find the locations and places you're interested in looking at.

If your system is configured for Node.js, and you have the npm package manager installed, you can install the utility with `npm install -g mapscii` or run `sudo snap install mapscii` if that's more to your liking. Press `q` to exit when you're done exploring.

comprising Eddy executable into a directory in your $PATH such as /usr/local/bin.

Encrypt anything

For the modern computer user, sensitive information comes in all shapes and sizes, be it text or PDF files, or even image and video files. You can use Eddy to encrypt all manners of files with the `eddy encrypt <filename>` command.

You're prompted to provide a password and then Eddy stores the encrypted file in the current working directory as filename.eddy.

```
$ eddy enc Bus\ Ticket-Delhi-Jaipur-08Feb2025.pdf

🔒 Bus Ticket-Delhi-Jaipur-0...
(63.05 KiB) [--------------------------------]

✨ Done in 380ms
$ ls Bus*

'Bus Ticket-Delhi-Jaipur-08Feb2025.pdf'
'Bus Ticket-Delhi-Jaipur-08Feb2025.pdf.eddy'
```

You can run the `eddy -h` command for a quick introduction to Eddy commands, but here are the useful ones that you'll commonly use:

Command	Function
encrypt, enc, e	Encrypt the specified files
decrypt, dec, d	Decrypt the specified files
generate, gen, g	Generate a passphrase of specified length

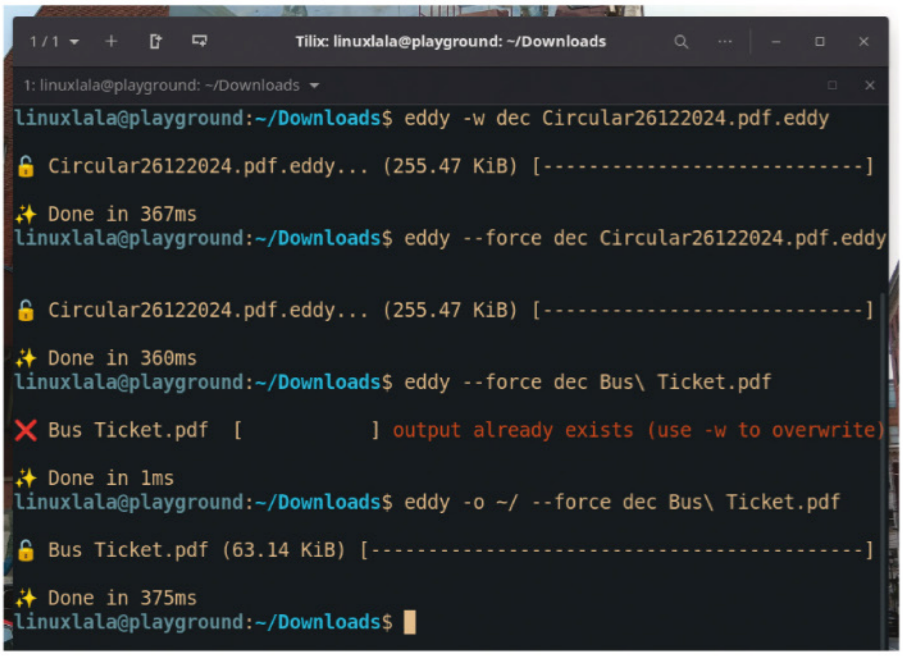
You'll notice the use of emojis in the output generated by Eddy to denote the completion of operations. Run all Eddy commands with the --no-emoji or the -n flag option to disable the use of colours and emojis in output.

Instead of being prompted for a password, you can also get Eddy to use a generated passphrase for added security. The command `eddy -g <passphrase length> enc <filename>` uses a passphrase of specified length to encrypt the file. If no number is specified, Eddy defaults to a passphrase of six.

```
$ eddy -g 8 enc Bus\ Ticket-Delhi-Jaipur-08Feb2025.pdf

🔑 NOTE: using this passphrase:
'proponent-calamari-playhouse-modify-avid-radiated-cranial-dipper'

🔒 Bus Ticket-Delhi-Jaipur-0...
(63.05 KiB) [--------------------------------]
✨ Done in 383ms
```



```
linuxlala@playground:~/Downloads$ eddy -w dec Circular26122024.pdf.eddy

🔓 Circular26122024.pdf.eddy... (255.47 KiB) [----------------------------]

✨ Done in 367ms
linuxlala@playground:~/Downloads$ eddy --force dec Circular26122024.pdf.eddy


🔓 Circular26122024.pdf.eddy... (255.47 KiB) [----------------------------]

✨ Done in 360ms
linuxlala@playground:~/Downloads$ eddy --force dec Bus\ Ticket.pdf

❌ Bus Ticket.pdf  [           ] output already exists (use -w to overwrite)

✨ Done in 1ms
linuxlala@playground:~/Downloads$ eddy -o ~/ --force dec Bus\ Ticket.pdf

🔓 Bus Ticket.pdf (63.14 KiB) [-------------------------------------------]

✨ Done in 375ms
linuxlala@playground:~/Downloads$ █
```

1 / 1
Tilix: linuxlala@playground: ~/Downloads
1: linuxlala@playground: ~/Downloads

Although Eddy offers to force-decrypt a file, bypassing the password check, the files so decrypted were not readable in our tests.

Take note of the passphrase used by Eddy to encrypt your file. You'll be prompted to enter it when you decide to decrypt the file.

The passphrase generator can also be used independently. In other words, you can run the `eddy gen <passphrase length>` command to generate a random passphrase of the specified length. You can then use it with any other tool or for any other purpose of your choosing.

Eddy is particular about the syntax of the command, and the flags must be specified before the command, so the structure of the command should be `eddy <flags> <command>`.

When encrypting files, Eddy doesn't delete, rename or otherwise interfere in any way with the original files. So, make sure you safeguard the original files, too, otherwise the whole exercise of encrypting them would be rendered moot.

If you have several files to encrypt, you can use Eddy to simultaneously encrypt all of them with the `eddy enc <filename> <2nd-file> <another-file>` command. Each of the files is individually encrypted as filename.eddy. That is, Eddy merely encrypts the files, and doesn't club them together. You'll have to create a tarball, and then feed it to Eddy if you want to make a singly encrypted file that comprises several files.

Decrypt away

All files encrypted with Eddy have the EDDY extension, which makes them easily identifiable. A unique feature of Eddy is that the encrypted files don't need to retain this EDDY extension. So, the encrypted circular.pdf.eddy file can be renamed as youcantopenthis.pdf and Eddy can still decrypt it when called upon to do so.

If you don't specify an output directory with the -o command flag, Eddy decrypts the file in the current working directory. The exercise fails if a file with the same name already exists. To overcome this, you can use the -w or --overwrite command flags to overwrite the existing file when decrypting.

Run the `eddy dec <filename.eddy>` command to decrypt a file encrypted with Eddy. To specify a different output directory, you have to run the `eddy -o <output-dir> -w dec <encrypted-file>` command.

Here, we've specified the output directory with the -o flag, and used the -w flag to overwrite any existing file with the same name.

For now, it's not possible to provide a name for the decrypted file, which retains the original name of the file when it was encrypted. This is why your only recourse is to either use the -w flag and overwrite an existing file of the same name, or to always extract encrypted files to a new directory.

Eddy is a straightforward utility that doesn't have a vast dependency list and can be quickly installed and put to use by anyone. ■

Phone & tablet tips

Brilliant things to do on your device.

ANDROID & iOS

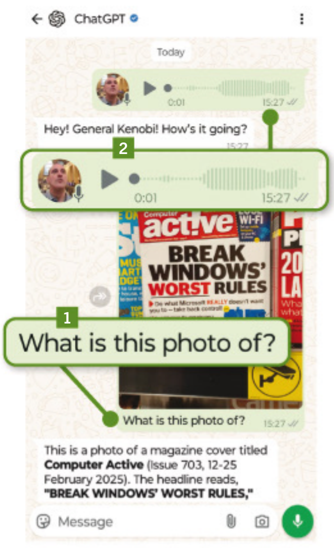
Use images and audio in ChatGPT WhatsApp chats

For some time now it has been possible to add the ChatGPT AI assistant as a WhatsApp contact so you can chat like you're messaging a friend. OpenAI has now expanded the feature to let you include images and voice notes in your WhatsApp conversations with the chatbot.

This means you can ask ChatGPT to analyse photos you upload or capture with your phone's camera, and tell you more information about their subjects. Just tap the paperclip or camera icon to add an image to your text query (1 in our screenshot right).

To interact with ChatGPT in WhatsApp using your voice, press the microphone button to record and share a voice message 2. The chatbot will detect what you're saying and respond accordingly in text form. You can then either submit another voice note, or continue the conversation by typing.

To add ChatGPT as a WhatsApp contact, tap the green plus-sign button and choose 'New contact'. Set 'ChatGPT' as the first name, then tap the dropdown menu under Country and select United States. Enter the number 1-800-242-8478 and press Save.



Hey! General Kenobi! How's it going?

What is this photo of?

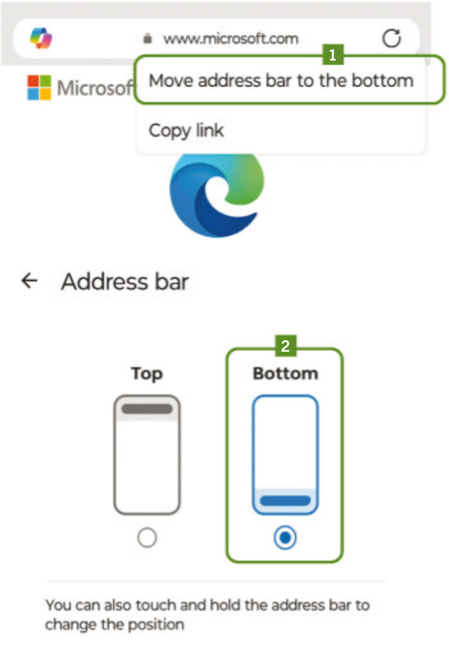
This is a photo of a magazine cover titled **Computer Active** (Issue 703, 12-25 February 2025). The headline reads, **"BREAK WINDOWS' WORST RULES,"**

ANDROID & iOS

Move Edge's address bar to the bottom

Like their desktop counterparts, many mobile web browsers have their address bars at the top of the screen. But when you're browsing one-handed on your phone or tablet, it's actually more convenient to have the address bar at the bottom, where it's easier to reach without stretching your fingers.

The Firefox app has its address bar at the bottom, as does Safari on iPhones (though not iPads), while Samsung's Internet browser lets you choose between top and bottom. They're now joined by Edge, which has added the option to move the address bar to its app for Android (**tinyurl.com/APC546edge**) and iOS (**tinyurl.com/APC546edgeio**).



You can also touch and hold the address bar to change the position

To relocate Edge's address bar, simply long-press it and select 'Move address bar to the bottom' (1 in our screenshot above right). If you don't see that option, tap the three-line menu button in the bottom-right corner of the browser and choose Settings, then Appearance. Tap 'Address bar' and select Bottom 2. You can move it back to the top in the same way.

ANDROID

Send yourself RCS messages in Google Messages

Google has updated its Messages app (**tinyurl.com/APC546rcs**) with the option to send yourself messages using the RCS (Rich Communication Services) protocol. Previously, you could only

---

Best new apps

What you should install this month

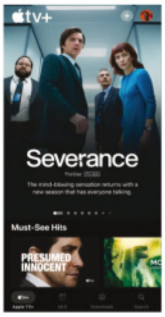
APPLE TV

Free*

Android tinyurl.com/APC546tv

iOS tinyurl.com/APC546tvio

Apple has finally made its TV app available for Android devices, seven years after it was released for iOS. This means you can now watch its Apple TV+ streaming service on your phone or tablet, as well as on your TV – and download popular shows such as *Severance* (pictured), *Slow Horses* and *Ted Lasso* to watch offline.



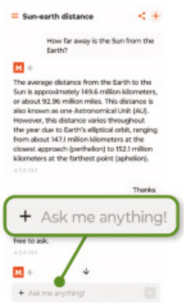
LE CHAT BY MISTRAL AI

Free*

Android tinyurl.com/APC546chat

iOS tinyurl.com/APC546chatio

As you can guess from its name, this new chatbot is from a French company but speaks perfectly good English. Le Chat provides impressively speedy and informative answers to your queries and can identify the subjects of images you upload. For unlimited responses and web searches, you'll need a $25 montly subscription.



How far away is the Sun from the Earth?

The average distance from the Earth to the Sun is approximately 149.6 million kilometers, or about 92.96 million miles. This distance is also known as one Astronomical Unit (AU). However, this distance varies throughout the year due to Earth's elliptical orbit, ranging from about 147.1 million kilometers at the closest approach (perihelion) to 152.1 million kilometers at the farthest point (aphelion).

Thanks

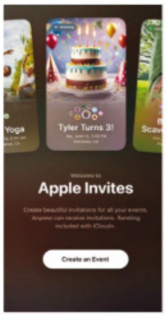
free to ask.

APPLE INVITES

Free*

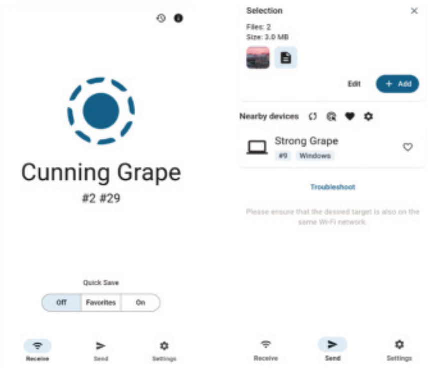
iOS tinyurl.com/APC546invite

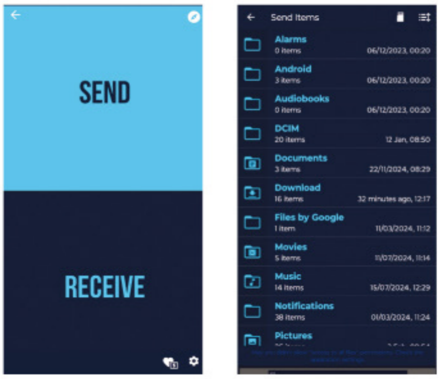
Apple's other new app this fortnight lets you create and share custom invitations for events. You can use your own photos, choose from a gallery of backgrounds to the venue, and add directions. You can even include the weather forecast for the day if it's outside. To create events, you need an iCloud+ subscription, but anyone can reply to your invites without one.

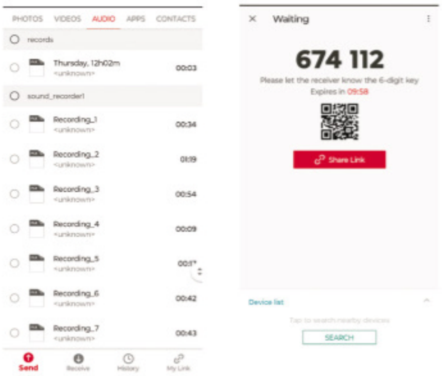


*Contains in-app purchases

Best apps for... Sending large files without email


Cunning Grape
#2 #29
Quick Save
Off
Favorites
On
Selection
Files: 2
Nearby devices
Strong Grape
Troubleshoot
Receive
Send
Settings


SEND
RECEIVE
Send Items
Alarms
Android
Audiobooks
DCIM
Documents
Download
Files by Google
Movies
Music
Notifications
Pictures


PHOTOS
VIDEOS
AUDIO
APPS
CONTACTS
Recording_1
Recording_2
Recording_3
Recording_4
Recording_5
Recording_6
Recording_7
Send
Receive
History
My Link
Waiting
674 112
Share Link
Device list
SEARCH

LOCALSEND

Free

Android tinyurl.com/APC546local

iOS tinyurl.com/APC546localio

This brilliant app lets you share files instantly between your phone, tablet and PC over your Wi-Fi network. LocalSend automatically detects other devices that have its app installed and open, so you can send and receive photos, videos, documents and other items with a single tap. You don't even need to sign up for an account.

Best for: Sending to nearby devices

SEND FILES TO TV

Free*

Android tinyurl.com/APC546files

This app lets you send photos, videos and other large files from your Android phone or tablet to your TV, so you can view them on the big screen. Install its app on your Google/Android or Fire TV device and choose Receive. Now tap Send in the app on your mobile device and select the files to transfer. Pay $6.99 to remove ads.

Best for: Sending files to your TV

SEND ANYWHERE

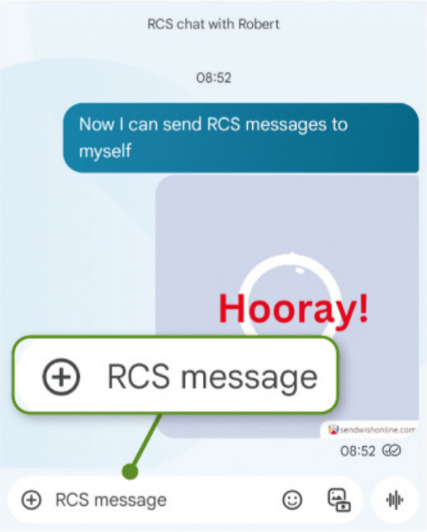
Free*

Android tinyurl.com/APC546send

iOS tinyurl.com/APC546sendio

Since WeTransfer downgraded its free plan to 10 shared files a month, Send Anywhere has become the most flexible file-transfer service. It places no limit on the number of files you can share, provided they're less than 10GB in size. Just send the recipient a link to the shared item, and they can download it by entering a six-digit code.

Best for: Sending files to other people


RCS chat with Robert
08:52
Hooray!
RCS message
08:52
RCS message

Now I can send RCS messages to myself

message yourself via SMS, which meant you could be charged by your mobile network for attaching photos and videos not covered by your monthly data allowance. RCS lets you send images and other files for free, provided the recipient is also using RCS, which obviously will be the case when you message yourself. It means you can write yourself notes and reminders, containing high-quality photos, videos and audio files, without being charged by your network.

It also lets you check that content displays correctly before sending a message to someone else. WhatsApp introduced a similar 'message yourself' option in 2022.

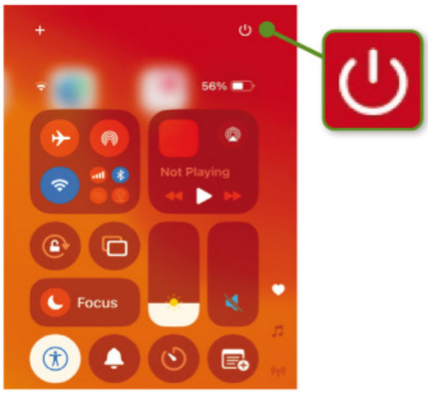
To confirm the Messages app (which comes installed on all Android phones) is set to use RCS, look for 'RCS message' in the message box (see screenshot above) when you start a conversation with yourself. If it says 'Text message' instead, tap your profile picture in the top-right corner of the app and tap 'Messages settings'. Select 'RCS chats' and switch on the option 'Turn on RCS chats'.

iOS

Turn off your iPhone or iPad more easily

Many of the changes implemented by Apple's last few iOS updates have related to its Apple Intelligence AI feature, which is only available on newer iPhones and iPads. One useful new option you can use on any device running iOS 18 lets you power off without pressing any physical buttons.

Instead, swipe down from the top-right corner of your screen to open the Control Centre and press the new power button that appears in the very top right (see


56%
Not Playing
Focus

screenshot above). Drag the on-screen slider to the right to turn off your iPhone or iPad instantly. You'll need to use the physical power button (on the side or top, depending on your device) to turn it back on.

Another handy addition in iOS 18 lets you enlarge the app icons on your home screen and remove the labels below them. This makes your screen look less cluttered and individual apps easier to open – especially on an iPhone. Long-press your home screen and tap the Edit button that appears in the top-left corner. Choose 'Customise' and select Large in the panel that opens. Your app icons will then enlarge and their labels will be hidden. Select 'Small' to restore them. ■

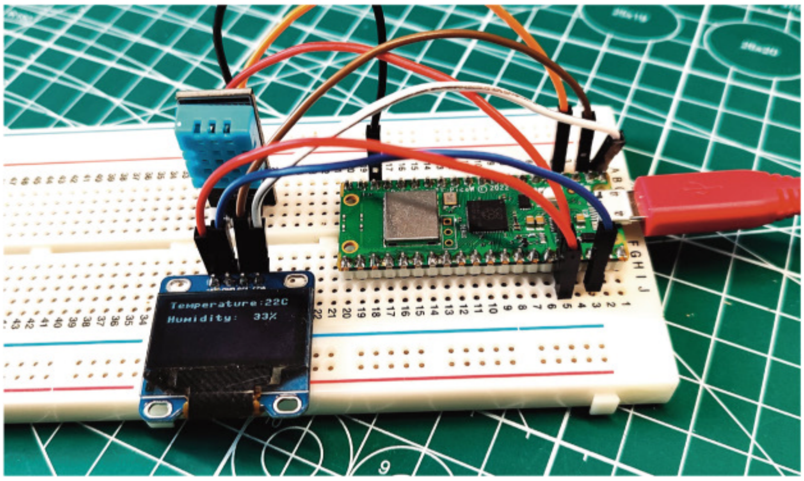
Frost-free fruit with a Pi Pico

Les Pounder grows strawberries in his garden, but now he has planted a Raspberry Pi Pico, hoping for a fresh crop of raspberries.

YOU'LL NEED

- Pi Pico W or Pico 2 W
- Breadboard
- DHT11 temperature sensor
- I2C OLED 128x64 pixel display
- 7x M2M jumper wires
- Code: **https://bit.ly/lxf328code**

The build for this project can be easily transferred to a PCB, Veroboard and so on, and integrated into a 3D printed case.



In this tutorial, we're building something to keep our strawberries safe from frost. Using a DHT11 temperature sensor, an OLED display and a Pico W, we will get live temperature data displayed on the screen and an alert to a smartphone using Ntfy.sh.

The circuit for this project is broken down into two parts. The input is our DHT11 temperature and humidity sensor, which connects to the Pico's 3.3V output, GND and the data pin to GP2. The OLED display connects to 3.3V, GND and to SDA (GP0) and SCL (GP1). See the high-res diagram, available in the download for this issue.

Coding the project

We're going to assume that you have already installed Thonny for the Raspberry Pi Pico. If not, Tom's Hardware has a guide to help: **www.tomshardware.com/how-to/raspberry-pi-pico-setup/**.

Open Thonny and connect the Pico to your machine. Go to Tools > Options and select the Interpreter tab. Set the interpreter to MicroPython (Raspberry Pi Pico) and set the Port to match the location of your Pico. Click OK. Thonny now connects to the board and we can start writing code.

Click on Tools > Manage Packages and search for micropython-ssd1306. Click on install and Thonny copies the files to the Pico.

Create a new file (File > New) then import a series of libraries. The first is DHT, for our sensor, time to control the pause, machine's Pin and I2C classes for the GPIO, SSD1306 for our OLED screen, network for Wi-Fi, and finally urequests to send data from the Pico:

```
import dht
import time
from machine import Pin, I2C
from ssd1306 import SSD1306_I2C
import network
import urequests as requests
```

Next, tell the Raspberry Pi Pico where the OLED screen is connected. It uses I2C for a connection, so we have to specify the GPIO pins, and then create an object, oled, to represent the display:

```
i2c=I2C(0,sda=Pin(0), scl=Pin(1), freq=400000)
oled = SSD1306_I2C(128, 64, i2c)
```

Create an object, sensor, to represent the DHT11 temperature sensor:

```
sensor = dht.DHT11(Pin(2))
```

To get the Pico online, create an object, wlan, and then turn on the Wi-Fi, before connecting to the Wi-Fi access point:

```
wlan = network.WLAN(network.STA_IF)
wlan.active(True)
wlan.connect("YOUR WIFI AP", "YOUR WIFI
PASSWORD")
```

Add a pause between requesting the connection and then checking the connection status:

```
time.sleep(2)
print(wlan.isconnected())
```

Using the oled object, blank the screen:

```
oled.fill(0)
oled.show()
```

Using a conditional test, check if the Wi-Fi has connected successfully. If it has (True), update the OLED screen to show 'Wi-Fi Connected' in the top-left (0,0) of the display. If the Wi-Fi fails, a different message appears. The oled.show() line updates the display with the correct text, then it pauses for five seconds before the main body of code starts:

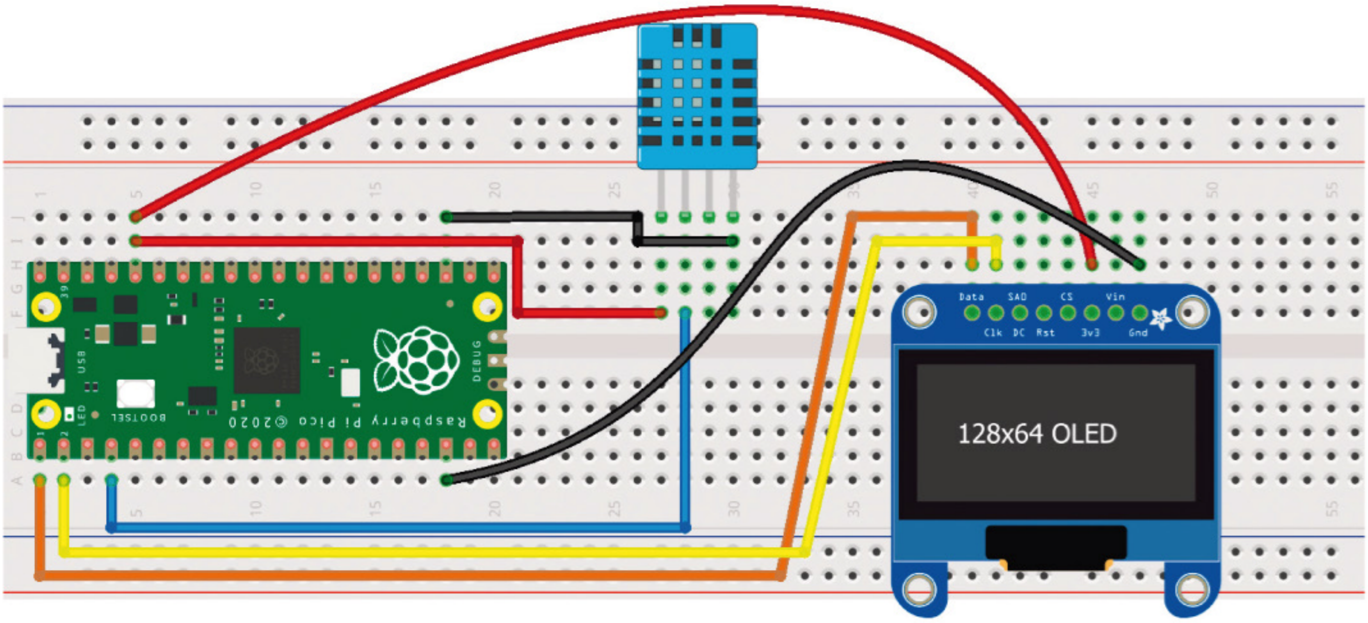
```
if wlan.isconnected() == True:
    oled.text("Wi-Fi Connected",0,0)
else:
    oled.text("Disconnected",0,0)
oled.show()
time.sleep(5)
```

Inside of a while True (forever) loop, we clear the OLED display before taking a reading using the DHT11, followed by a short pause:

```
while True:
    oled.fill(0)
    oled.show()
    sensor.measure()
    time.sleep(1)
```

Create two objects, temp and hum, and in them, store the current temperature and humidity reading, rounded to two decimal places:

```
   temp = round(sensor.temperature(),2)
   hum = round(sensor.humidity(),2)
```



The circuit has two parts: the input (DHT11) and the output (OLED display), with only seven wires needed for connection.

Print values to the Python shell for debug purposes:

```
print(temp, hum)
```

The OLED display displays the live data. Starting from the top-left, we print ‘Temperature’, then moving down 16 pixels, we print ‘Humidity’:

```
oled.text(“Temperature: “,0,0)
oled.text(“Humidity: “,0, 16)
```

To insert the values, we use the oled.text() function, but pass the data as strings, not integers/floats as it causes errors. The position of data is passed using X, Y coordinates. The temperature is on the first line, so we set the Y value to zero, but the X value (horizontal) is 95, giving it space from the ‘Temperature’ text. The same practice is applied to the humidity data:

```
oled.text((str(temp)+”C”), 95,0)
oled.text((str(hum)+”%”), 85, 16)
oled.show()
```

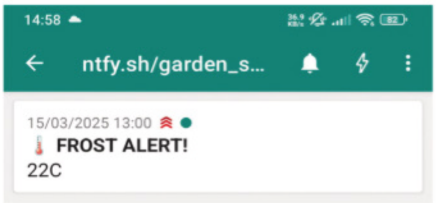
Now let’s add notifications on our smartphone using Ntfy.sh. To use it we need an Android or Apple device. Download the app from the app store and open it. We need to subscribe to a topic, so click on the + in the bottom-right. In the Subscribe To Topic dialog, set the topic name. We used ‘garden_shed’, but remember that this is a public topic, so anyone can see the output. Make the topic name unique and click Subscribe. The topic page appears, where all the messages for our topic are archived. Go back your phone’s home screen – that way notifications appear when we test the code.

Back to the code on the Pico. A conditional test is used to read the value stored in the temp object. If the temperature drops below this value, using requests we construct a message that is sent to Ntfy.sh. The message is told the name of the topic, and the data we wish to send (in this case the current temperature). The headers section is used to set the title, ‘FROST ALERT!’, and the priority (five being the highest). Tags are used to inject an emoji into the message for easy identification. Note that the temperature of 25 is used for testing; set this lower for your trigger temperature:

```
if temp < 25:
    requests.post(“https://ntfy.sh/garden_
shed”,
            data=(str(temp)+”C”),
            headers={
              “Title”: “FROST ALERT!”,
              “Priority”: “5”,
              “Tags”: “thermometer”,
              })
```

If there is no frost, the else condition uses pass to loop, before the code pauses for one hour (3,600 seconds). Then the process repeats itself.

Save the code as main.py to the Pi Pico W. This runs the code when the Pico W is powered up. Power cycle the Pico and watch the OLED display. You should see ‘Wi-Fi Connected’ followed by the current temperature and humidity. If you left the temperature at 25°C, the alert should appear on your phone. ■


14:58

ntfy.sh/garden_s...

15/03/2025 13:00

🌡 FROST ALERT!

22C

Ntfy’s app is very easy to use and you will soon be sending data from your Pico W to your phone.

HANDY NTFY.SH REFERENCE GUIDES

Ntfy.sh has become one of our go-to tools for notifications. Sure, we love MQTT, but Ntfy.sh is much easier to use.

The basic guide on how to publish a message is at **https://docs.ntfy.sh/publish/** and from there we can learn how to send notifications via Python, JavaScript, Go and even cURL. We’ve even managed to use it with Node-RED!

The guides also explain how to add an image, so using Ntfy.sh with the Raspberry Pi camera or webcam means we can send notifications if a sensor is triggered. To attach an image, we add Attach to the headers and then pass the path to the image. Note that you need the absolute path, be it a local file or an image from the internet.

What if we want to action something when a notification arrives? The Ntfy.sh example is a dog ringing a doorbell. The notification tells you that the dog wants to gain entry, but the door is locked. The Actions option in the header means we can trigger an event to happen. In this case, the dog is let in after calling the doorbell’s API via HTTP: **https://docs.ntfy.sh/publish/#action-buttons/**.

Finally, if you want to use cool emoji, Ntfy.sh has a list that you can crib from. Just copy the text to the project code and the emoji will be sent with your message: **https://docs.ntfy.sh/emojis/**.

DOWNTIME

The games we play

apc
HIGHLY RECOMMENDED

One of the greatest RPGs of all time is back.

PRICE $84.95 **PLATFORM** PC **WEB** tinyurl.com/APC546oblivion

Elder Scrolls 4: Oblivion Remastered

Oblivion Remastered is a beautiful wonder.

What an astonishing – and completely unexpected – treat this is. Out of nowhere with no advance warning comes this remaster, and it is glorious. It is the entire original *Oblivion* game fully reworked using the super sophisticated Unreal Engine 5, and it looks absolutely beautiful. But that's not all, many gameplay tweaks have been made too, removing many of the old headaches and gifting us with a game for *Elder Scrolls* old timers and newbies alike.

If you've never played an *Elder Scrolls* game before, this is the place to start. No, not *Morrowwind* – this. Then *Skyrim*, and then when it is eventually released, *Elder Scrolls* 6.

Back in 2006 when it was released, *Oblivion* stunned the gaming world with its vast sandbox environment that rewarded exploration with a sense of freedom and awe. Then, as now, you'd busy yourself with the main mission and its literal world-changing impact on the lands of Cyrodiil, picking up side quests along the way, and doing Guild quests eventually, only to discover they were actually the best bits.

The Remaster doesn't change any of this, it just makes it infinitely more beautiful. Honestly, the graphics could pass today as anything from a new AAA release. The new engine is a little different in that it doesn't feature the highly saturated and somewhat mystical colour palette as the original, but it looks great and the mods are already flooding in, so it's as customisable as the original. And that's a big part of the appeal because it's hard to find a more talented and dedicated modding community that the *Elder Scrolls* fan base.

Gameplay tweaks include changes to the notoriously painful levelling system, and with that more freedom to do any quest you like at any point in the game without adverse effect.

Large chunks of the dialogue have also been re-recorded. It's the same charmingly clunky script, but now with more polished voice acting.

For buyers of the *Deluxe Edition* several new quests have been added, and you get access to the *Shivering Isles* and *Knights of the Nine* expansions, which I strongly recommend as they're up there with some of the best RPG adventuring of any game, ever.

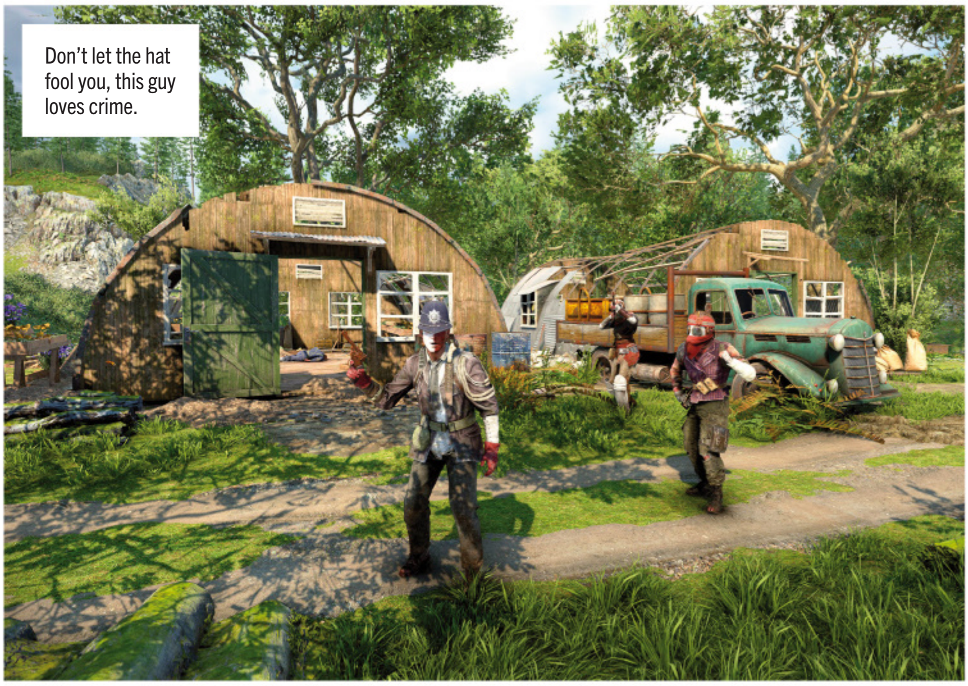
The developer Virtuos has delivered the gaming surprise of the year, taking the core nuts and bolts of one of the most absorbing RPGs ever made and recreating it in (debatably) the most advanced 3D engine today. While many will argue, I think *Oblivion* is a more enjoyable game experience than the much-vaunted *Skyrim*, and for free-roaming escapist joy nothing comes close today.

VERDICT

★★★★☆

The *Oblivion* you've always known and modded with a few tweaks and a fresh coat of polygons on top.

Ben Mansill



Don't let the hat fool you, this guy loves crime.

PRICE $73.50 **PLATFORM** PC, PS4/5, XB1/S/X **WEB** atomfall.com

Atomfall

A muddled misadventure in need of a stronger identity.

I've spent years wandering many an inhospitable wasteland, so *Atomfall*'s pleasant post-apocalypse is pretty inviting. They've got tea here. And bakeries. And it's extremely green – not because of radiation storms, but because it's all pastures and woods and verdant hills as far as the eye can see. It'd be a nice place for a ramble, if it weren't for the fire-spewing robots, lethal flora, bandits, cultists and conspiracies.

With its '50s-inspired retro-futuristic setting, *Atomfall* has needed to contend with the spectre of Fallout since it was first unveiled, but the similarities are only surface deep. That shallowness is probably *Atomfall*'s defining feature: it's chock full of systems and obvious inspirations, but it rarely digs into them and struggles to set itself apart.

Rather than traditional quests, *Atomfall* doles out leads, which are basically just quests with a bit less hand-holding and a more investigative bent. Sometimes you'll discover an interesting building, hear rumours about a point of interest, read a letter that reveals another conspiracy, or get sent on an explicit task – all of these could be leads, which then come with subtasks and get fleshed out by your findings.

Atomfall has problems though in its approach to combat and survival. By the end of the game I was trying to avoid most fights simply because their simplicity couldn't make up for their repetition.

Melee's in a rougher state. The scarcity of ammo suggests melee is the way to go, but you can't dodge or block, which turns these brawls into slogs where you're just slashing away while walking backwards.

There's fun to be had here, but *Atomfall* is undone by its fear of commitment. It never really goes all in on anything. It dabbles. Some basic crafting. A bit of simple stealth. The tiniest bit of NPC factional rivalry.

As compelling as the mystery of the Windscale disaster is, with all of its leads and conspiracies, it's not enough for a central hook. Like everything else in *Atomfall*, Rebellion doesn't take it far enough.

VERDICT

★★★½☆

Rebellion's *Atomfall* can be an excellent, fun diversion, but it really needs to take a gap year so it can find itself.

Fraser Brown

apc HIGHLY RECOMMENDED

PRICE Free **PLATFORM** PC
WEB tinyurl.com/APC546vendran

VENDRÁN LAS AVES

ENERGY IS HARD TO COME BY. *Vendrán las aves* is a game about dealing with work-induced burnout. In this narrative time management game you've taken a year off from your job and bought a new electric guitar, which is surely the perfect recipe for a year of joyful musical expression from the comfort of your flat.

Turns out humans rely on energy, which is in short supply after work has drained the last joule from you. So while you might want to 'shred' your 'axe' the reality is that you have just enough energy to have a shower or cook a hot meal – but not usually both. It's a frustrating game to play, and that's just the right tone as it's a frustrating place to be in life, with all the time in the world at your disposal but you just can't will yourself to do what you want to.

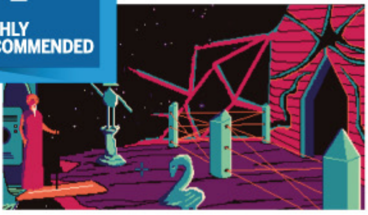
I won't spoil the ending, which ultimately ends somewhere beautiful to show the joy that can (eventually) exist on the other side of work.

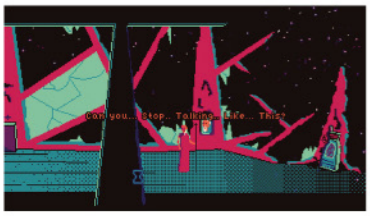
VERDICT

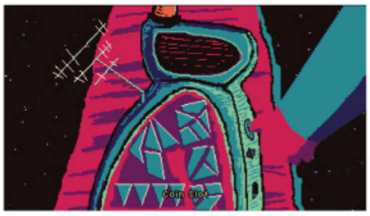
★★★★☆

It could explain itself better, but *Vendrán las Aves* is a game that will undoubtedly speak to a lot of people.

Tom Sykes







PRICE Free **PLATFORM** PC, Linux
WEB tinyurl.com/APC546time

THE SPHINX OF TIME

MAKE TIME FOR THIS.

It's the rare adventure game these days that prioritises puzzles, so it was a delight to fire up *The Sphinx of Time* and be presented with puzzles that would fit in nicely in the genre's golden age. Time has stopped, and you've flown to a space museum to start it.

In your mission to summon the *Sphinx of Time*, who has the power to repair the universe, you have to switch on and operate an alien machine, although this is easier said than done. It's a puzzle that will have you travelling back and forth through the museum, making notes as you switch between two characters.

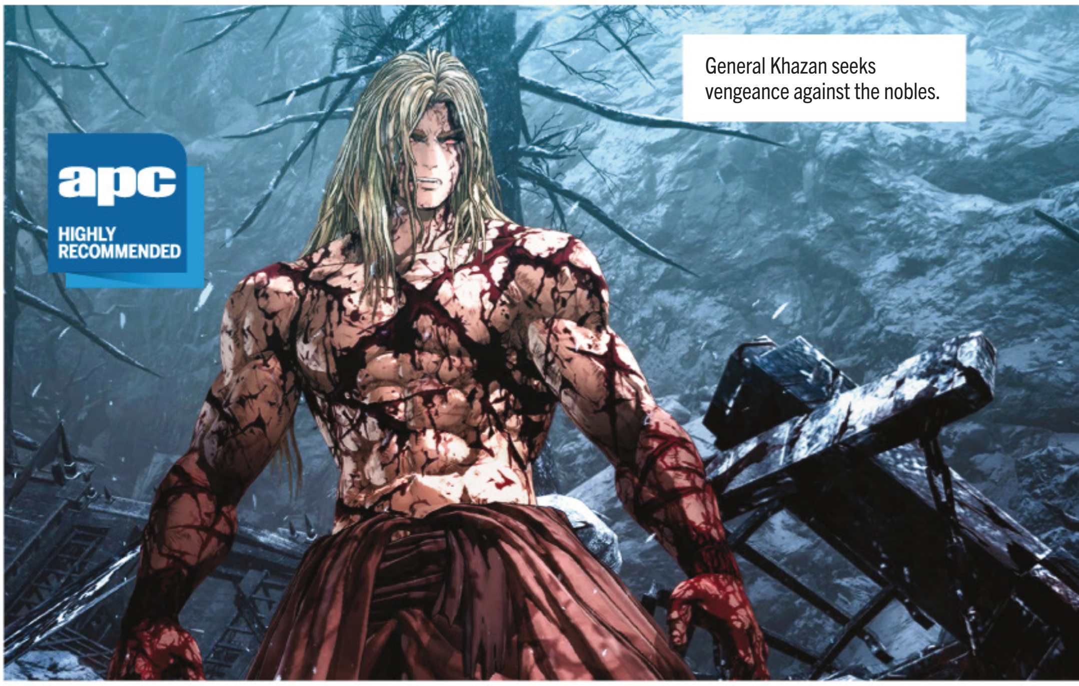
The aesthetic of *Sphinx of Time* is impressive as well too, with its colour palette comprised overwhelmingly of sumptuous purples and reds, and its giant, detailed character sprites that are full of personality, if quite static in their actual animation. It's a funny game, retaining a consistently silly tone throughout, even if nothing ever lives up to the punchline shock of its Douglas Adams-esque opening moments just as much.

VERDICT

★★★★☆

Puzzle your way towards the game's trippy conclusion.

Tom Sykes



General Khazan seeks vengeance against the nobles.

PRICE $84.95 **PLATFORM** PC, PS5, XBS/X **WEB** tinyurl.com/APC546berserk

The First Berserker: Khazan

Reap bloody Soulslike vengeance.

As with many Soulslikes in recent years, *Khazan* apes quite a few of *Dark Souls*' more-than-familiar combat mechanics – whether deflecting to build a gauge and stagger a boss, or avoiding unblockable attacks that flash red. But more than perhaps any other Soulslike I've played, *Khazan* successfully adds its own twists to these timeworn mechanics, while providing a lineup of fantastically designed bosses who make you dance like a monkey as you learn them.

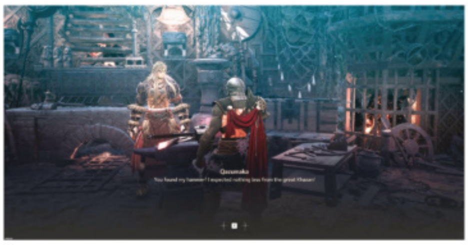
Like *Demon's Souls*, Khazan is a series of linear missions that you portal to via a hub, as the eponymous general battles through each map on his journey of vengeance to reach a final boss. Though these missions can feel kind of samey after a while, with a lack of exploration, significant NPC quests or verticality – you can't jump – *Khazan*'s combat and boss battles are enough to carry it.

Your three weapons – a dual-wield sword and axe, a glaive and a greatsword – each have dedicated skill trees, and its armour uses the same bonus system as *Black Myth: Wukong* when equipping multiple pieces from a set. Its combat follows a similar resource model as you accumulate Spirit; points you then use to perform weapon skills.

Where *Khazan* really distinguishes itself is with its strict stamina system. Skills don't consume stamina, so you use them to supplement attacking and defending, throwing out combos almost like a fighting game to deal as much damage as you can.

Khazan isn't a game that you can brute force, though. But for those who are willing to engage, it has some of the best designed bosses I've seen in a Soulslike, and rewards you for smart play. Though the story is nothing to write home about, it accomplishes the most important thing with its anime-esque art style: giving us a greatsword that feels amazing so we can pretend it's *Berserk*.

If you're still unsure, try *Khazan*'s quite generous demo on Steam and battle to the Blade Phantom boss – this is where things will click into place if they're going to.



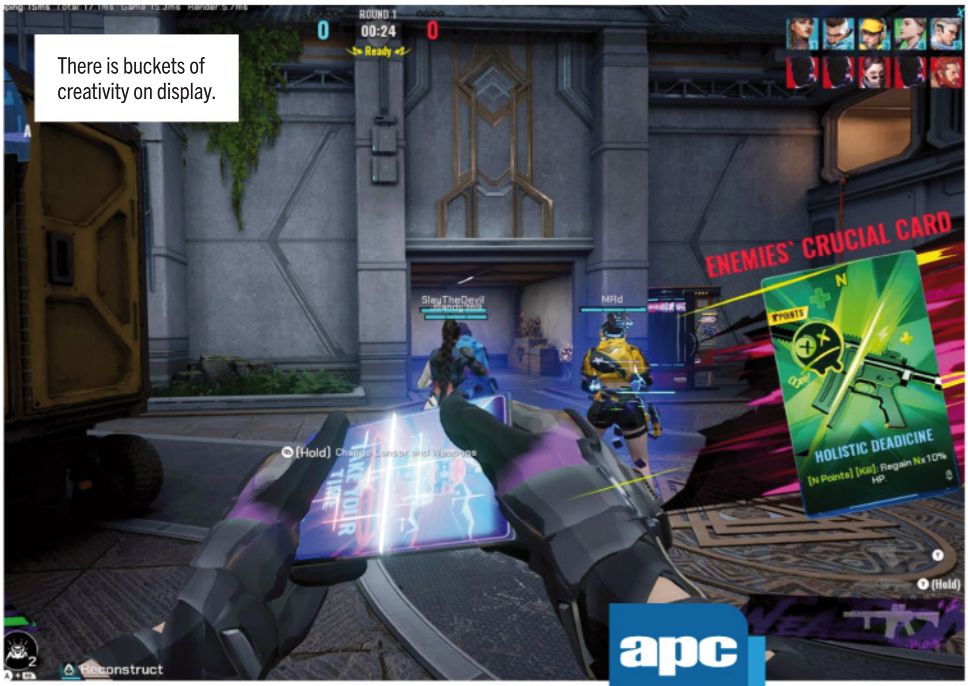
The blacksmith crafts new weapons, armour and consumables.

VERDICT

★★★★☆

Khazan's stellar boss design and combat more than make up for samey missions and a flat protagonist.

Sean Martin



There is buckets of creativity on display.

PRICE Free **PLATFORM** PC, XBS/X **WEB** fragpunk.com

HIGHLY RECOMMENDED

Fragpunk

Offers a thrilling approach to competitive shooters.

Fragpunk takes the basic formula of *Counter-Strike* and *Valorant*, with each 5v5 Shard Clash match consisting of defenders protecting a bomb site and attackers trying to plant the bomb, but its matches are much shorter. Quick play is the first to four round wins, and ranked is the first to six. This gives each match an urgency that pairs well with the unpredictable cards and faster pace:

As you kill members of the enemy team, plant the bomb, defuse the bomb, land assists and complete rounds, you earn points to spend on Shard Cards before each round. Some of these cards involve having to scream and shout louder in voice chat to boost your movement speed or let your character lie down and nap to heal. There are also objective cards that allow you to plant the bomb anywhere or throw it to have it auto-plant itself.

The creativity on display here is leaps and bounds ahead of any other competitive FPS. It's exhilarating as a player to suss out an advantageous combination in the moment, and even more gratifying to be constantly surprised by what I can do in the game because of them. It is just so refreshing to play something so unconventional in a genre that is often stale.

Fragpunk also breaks from some other conventions: between rounds you can switch your Lancer (aka hero) and weapons. There is no money; there are just limits on the number of rounds you can finish with a weapon type.

ATTACK
SONAR

Sonar's side hustle is professional loo unblocker. Fact.

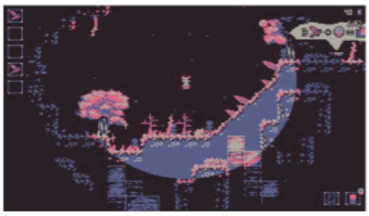
I'd consider the gunplay, sound design, and movement to be as good as any other shooter available today, with a distinctive blend of the precise aim needed in *Valorant* and *CS* and the faster movement found in *Apex Legends*. Everything is animated and presented like an animator's sketchbook: I love the little flair effects when you land headshots, and the game's maps, Lancer designs, and menus are coursing with colour and dripping with personality.

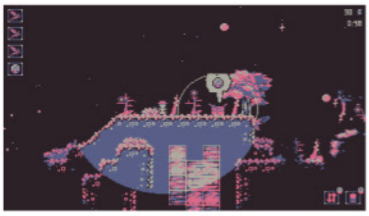
VERDICT

★★★★☆

Fragpunk's bold decision to break almost every rule in the book leads to a captivating shooter.

Echo Apsey





HIGHLY RECOMMENDED

PRICE Free **PLATFORM** PC
WEB tinyurl.com/APC546gravity

GRAVITY BOOTS SALESMAN

SELLING ON THE CEILING.

People need their gravity boots, particularly people floating in mid-air, and it's your job to supply them in this lovely platform game, which has you selling as fast as you can. You have your own pair, which certainly helps as you invert gravity to help all the folks floating off the ceiling.

It's a loose and friendly game, with no fail conditions and only your high score to beat. You get a point for every person you help, and you do this by mixing crafting components and taking the resulting boots to one of the customers floating on this planet.

That's one way to play the game, but let me share a different tactic with you. You can use your cash to buy optional upgrades that will give you more mid-air jumps or let you hold more crafting components.

It's a wee *Metroidvania*, optionally. You could also just run back and forth from the crafting station, seeking customers that have wandered near the ground, and that's a legitimate way to rake in the points.

VERDICT

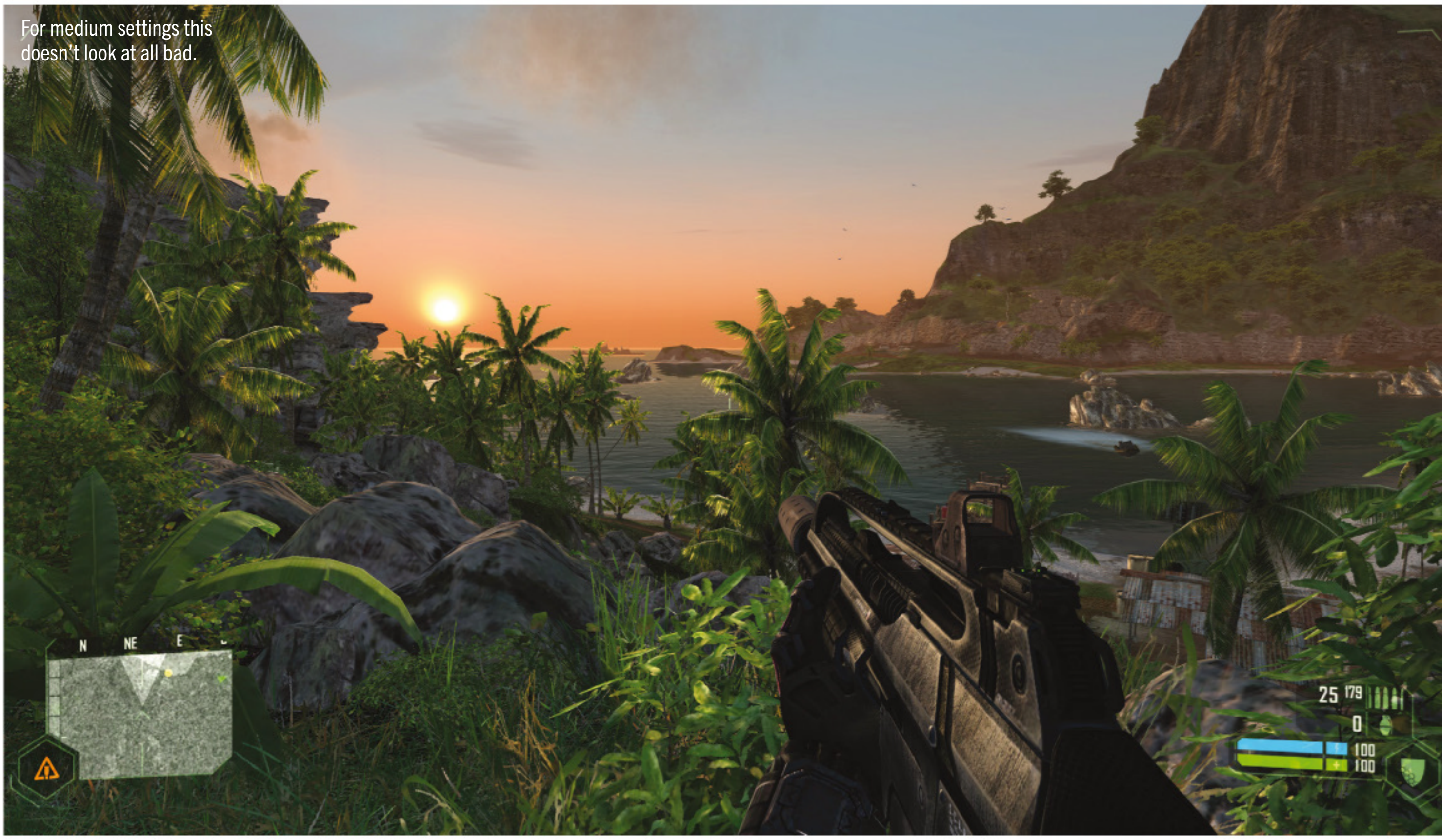
★★★★☆

Some flawed mechanics but overall great fun.

Tom Sykes

GAME CHANGER

Old games, new perspectives



For medium settings this doesn't look at all bad.

RELEASE 2007 **DEVELOPER** Crytek **PUBLISHER** EA **LINK** s.team/a/17300

Crysis

Notorious for melting GPUs, it needed 18 years to mellow. By Ian Evenden

***Crysis* became a meme for its high graphics requirements, but it's almost 20 years old – surely modern systems have advanced far enough to do it justice? Well… kinda.**

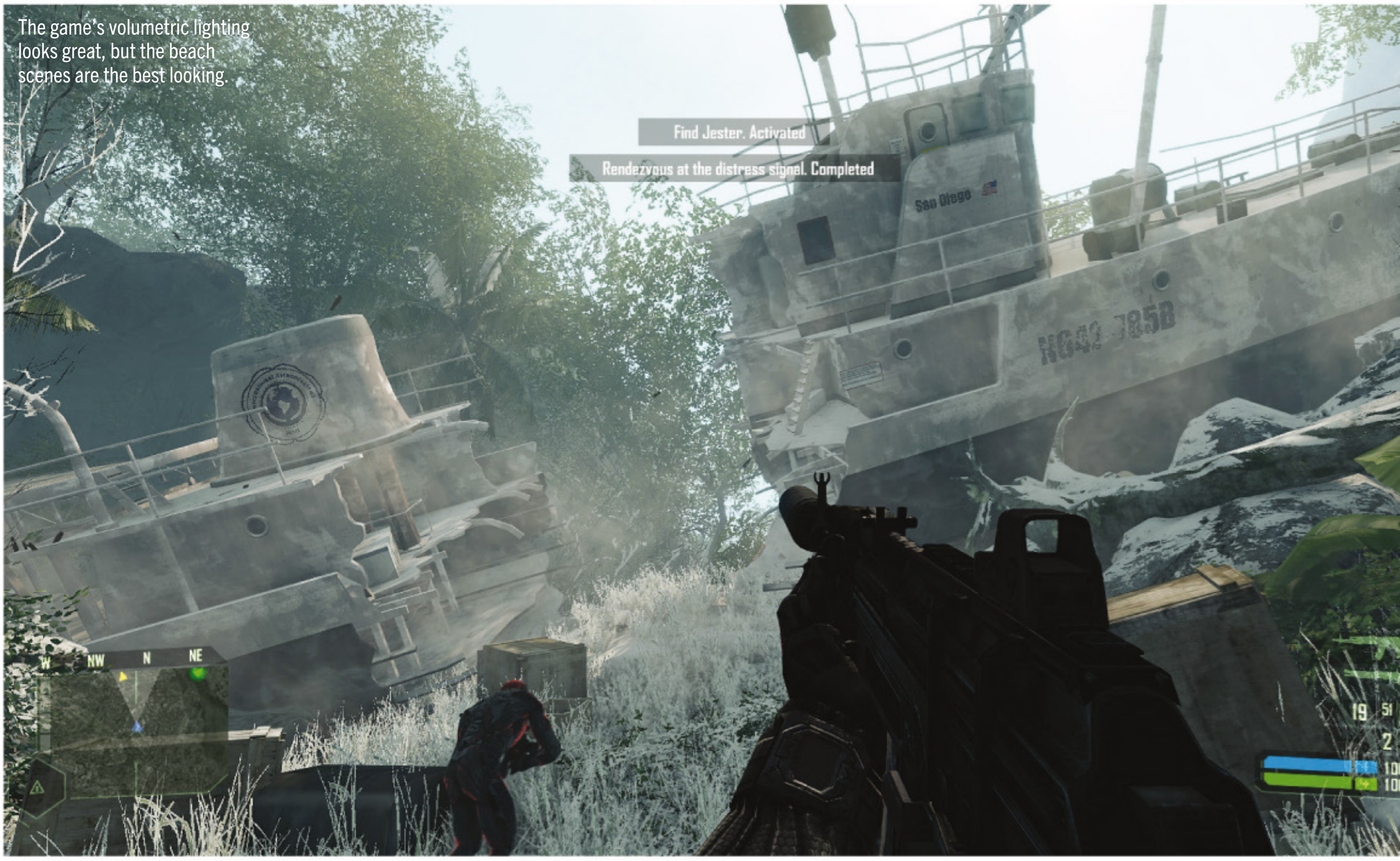
I'm reinstalling plain old *Crysis* here, not *Crysis Remastered* or the version from the *Crysis Trilogy* set, which means I'm not benefitting from any quality of life improvements that came with the newer releases. It's the standard version you get from Steam, and it won't run on my gaming PC. That's right, a PC with an RTX 3080 in it is unable to run *Crysis*. Sadly for the meme-sters, it's probably a software or driver issue rather than a lack of rendering power, it just stops dead and resets back to the Steam library page instead of attempting to render a slideshow. None of the solutions I unearth from the internet work, so I move to my backup PC.

This is a mini-PC that has a Core i9-13900h in it, and a useful 32GB of RAM, but no discrete GPU. The recommended graphics card for *Crysis* is a GeForce 8800 GTS, a card from 2007's Tesla generation that can have as much as 640MB of VRAM but more usually came in a 512MB configuration with a 256-bit bus. This gives it a peak performance of around 416 GFLOPS, while the integrated Iris Xe GPU in the i9 returns 1.7 TFLOPS. Theoretically, of course. For comparison, the RTX 3080 that's frustratingly unable to play *Crysis* is capable of almost 30 TFLOPS.

This looks good for *Crysis* on integrated graphics, but there's a further hitch. My mini-PC is hooked up to a 4K monitor, and the game is unable to run in fullscreen at anything less than 4K resolution. Lower settings work, but run in a window that's so small I'm left peering at the screen in a way unbecoming of a serious journalist. Ticking the 'full screen' option in the game's settings doesn't solve the problem, and after some experimentation with the game's performance analyser and the Game Bar's frame counter, I'm left with medium settings.

Fear of missing out

The GeForce 8800 GTS couldn't output 4K, topping out at 2560x1600 if you used dual-link DVI, so I'm already ahead of gamers from 2007, and I'm amused by the Core 2 Extreme logo that appears on startup, wondering how gamers from that era would respond to the Raptor Lake chip's 24 cores.



The game's volumetric lighting looks great, but the beach scenes are the best looking.

The game runs, but medium settings have never sat well with me, and I'm left with the distinct feeling that I'm missing something.

Such is the life of a PC gamer, however. While consoles, with their fixed platforms that only update every five years or so, only inspire a longing for new hardware once every cycle, for PC players it's a permanent thing, and games like *Crysis* really don't help. This thing must have been responsible for more graphics card upgrades than just about any other piece of software. Incidentally, if anyone reading this has managed to achieve upgrade impulse control, perhaps through a combination of transcendental meditation and mind-bending drugs, please write in and let the entire hardware department know.

So, with high-res but medium quality settings and looking very much like an Xbox 360 game, *Crysis* is off and running. It's really not all that bad, with plenty of vegetation and the light gleaming off the palm trees, but there's a distinctly primitive look to everything. The one concession to modernity it manages is that Windows 11's Auto-HDR mode kicks in, though I'm not completely sure how much good it's doing. What's remarkable, though, is how modern it feels despite wanting nothing to do with the USB game controller I have plugged in.

Jungle is massive

I've migrated away from keyboard controls in the past years, the lure of yet another piece of hardware to upgrade just too much to resist, so going back to WASD and mouse aiming immediately shows how much my skills have degraded and how bad I've become at shooting when my hand's not being held by auto-aim. To begin with, I can't hit anything, spraying bullets around with abandon in a way that does not suit the highly trained recon soldier I'm meant to be playing as.

On the other side of the conflict, the North Korean troops I'm encountering are deadly accurate, even when firing from a moving boat at a figure crouched behind a rock hundreds of metres away. Perhaps turning off the flashlight attached to my rifle will make me less visible.

ANATOMY OF A CRYSIS

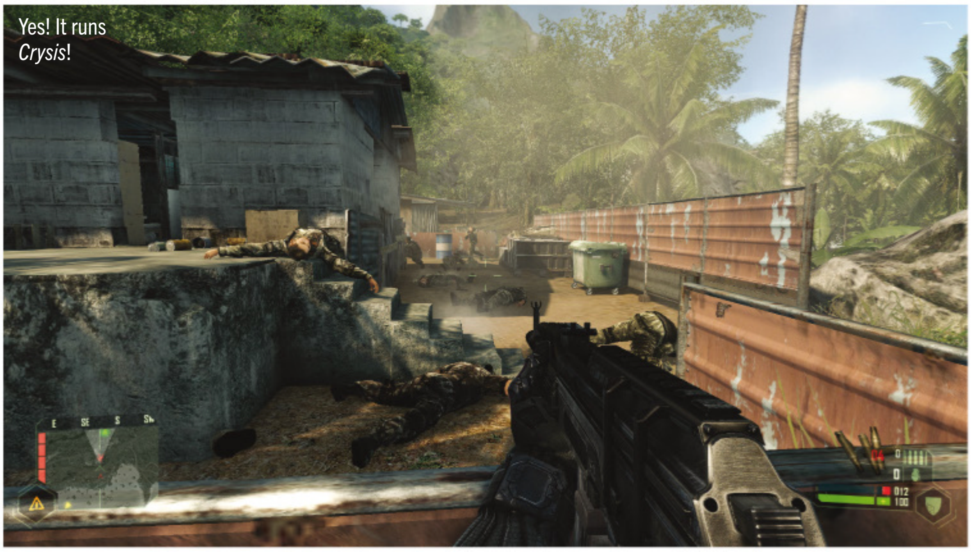
Bits of games you'll recognise after going back to 2007

FAR CRY
Well of course, they're from the same developer. Jungles, beach scenes, full-auto gunfire, soldiers giving way to weird sci-fi enemies. It's all here, just without any Hawaiian shirts.

HALO
Thanks to the way they call out your location (in English, though ingeniously on higher difficulties this switches to Korean) and use grenades, the soldiers can feel like you're fighting Elites.

GHOST RECON
The sneaky Clancy game launched in 2001, and its forested setting, along with the way it expects you to sneak up on groups of enemies before taking them out, has echoes in *Crysis*.

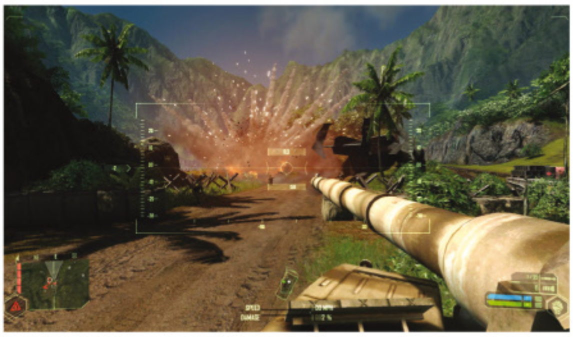
RESIDENT EVIL 4
The North Korean soldiers like to leave outboard motors laying around their encampments, which immediately reminded me of *Resi 4*'s third chapter, which opens with a lovely boat ride…

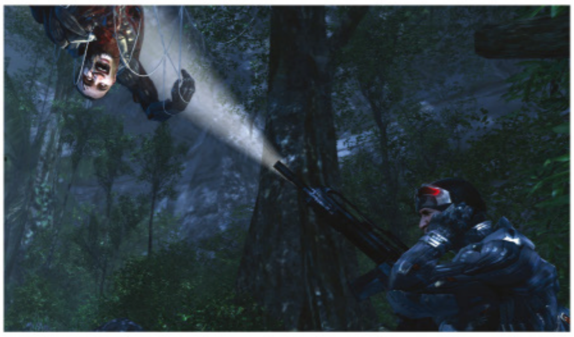


Yes! It runs *Crysis*!

FAR RIGHT Dammit Jester, turn off your light – do you want to be spotted?

LEFT Enemies always seem to know where you are – there's no getting away, even in a tank.





Crysis' apparent modernity makes sense when you stop thinking about it as an antique, which is tempting to do about a game from this era of the recent past. It's from 2007, 11 years after *Quake 2*, six years after *Halo*, three-and-a-half after *Far Cry*, and three years after *Half-Life 2*. The game is old, but not that old. We're not configuring DOSbox here.

Off I go again, into the jungle, and I have a settings breakthrough following a restart. Something has changed, I'm not sure what, and the game is now happy to run in 1080p fullscreen as long as I don't Alt+Tab out – doing this also disables the game's sound, so I quickly learn to avoid it. This means I can increase the quality settings to very high and still get 60fps, which is great, but now there's screen tearing all over the place. Enabling V-sync is the traditional way to deal with this, but doing that locks the framerate at 24fps. Which might be cinematic, but isn't why I'm here.

I decide that tearing is the lesser of all the evils, and eventually I compromise on 1080p, very high settings and some anti-aliasing, which results in a framerate in the 40s and 50s if you can deal with the tearing, which mostly happens when I whirl the camera around or fall down dead. Which I do a lot. There's also a heck of a lot of pop-in, boulders and trees visibly teleporting into position well within the field of view if you're faced with one of its few inland vistas (the sea and shoreline never seem to have this issue) which is probably why the game tries to keep things close as much as it can.

Hide and seek

This is an interesting lesson in how *Crysis* wants to be played. The North Korean soldiers, not to mention the chilly, squiddy beasties I'll be fighting later on, are tough. And while the game wants you to engage them up close, there's nothing to be gained from charging straight at them like I'm playing *Doom* even though I quickly pick up a shotgun. Instead, it casts you as a hunter. You're effortlessly superior to your foes, at least to begin with, but there are many more of them. This means you have to take the role of a predator, use your suit abilities, cloak yourself, pop out and take aimed, close-range shots, make sure your silencer is equipped, flush with grenades (something the enemy troops are adept at) and try at all costs to avoid getting drawn into a stand-up fire fight with the enemy in cover, because they'll win.

You're constantly forced to reevaluate your tactics, and the early game cries out for a long-ranged weapon with a proper sight so you can pick off the grunts from afar, something you're just not given. They appear intensely aware of their surroundings, responding to noise and the smallest sight of a nanosuit-clad American. Enter an area cloaked, however, and they exhibit much more relaxed behaviour – but the cloak never lasts long enough, and once you start shooting it's gone.

Reinstalling *Crysis* has taught me a lot about how I play and perceive games today, and how that has changed from the way things were when I was 18 years younger. Then, I was happy to press on through restarts and low quality settings, with hardware I desperately wanted to be better than it really was. *Crysis* remains immensely playable today, even on integrated graphics, but you're probably better off with the remastered edition. ■

STARTUP DISK
ALDUS
Startup disk
Insert into internal disk drive
PageMaker
For use with the Apple® Macintosh™

ABOVE PageMaker helped DTP become a $1 billion business by 1988.

PageMaker: read all about it

PageMaker's release 40 years ago kickstarted a revolution in the publishing industry. David Crookes leaves no page unturned to find out how it all unfolded.

Although Johannes Gutenberg invented the movable-type printing press around 1440, producing professional publications long remained a laborious and time-sapping endeavour. If you wanted to create a newspaper or a magazine for much of the first half of the 20th century, you needed skilled workers to use machines to manually assemble letters into lines – a process known as hot metal typesetting.

Even though production methods gradually became more refined thanks to cold type and offset printing, the process of putting words and images on a page remained cumbersome. As an example, in issue 14 of *Amstrad Action* printed in 1986, there was an article explaining how the magazine was made.

Text would be written on Amstrad CPC 464 and CPC 664 computers using a word processor called Tasword. It was then transmitted down the phone line to a typesetter called Wordsmiths in Somerset. A member of staff would drive over to pick up the finished bromide paper containing columns of text and hand it to the art team to cut up and lay out on large sheets.

It was a semi-manual paste-up process replicated on publications everywhere, with exacto knives and wax being tools of the trade. Camera-ready artwork would be sent to a professional printer and turned into negatives to create printing plates for offset lithography. But every adjustment had to be physical, and correcting mistakes was a slow and fiddly process.

Cut and paste job

Paul Brainerd, who began his career as assistant to the operations director at the Minneapolis Star and Tribune Company, knew there was a better way. He implemented a pre-press technology created by Atex, a company founded in Massachusetts in 1973. Having seen first hand how computers could make a difference to newspaper production, he ended up working for Atex himself in 1980.

In the same way Amstrad Action writers were bashing out words on computers, Atex's systems replaced typewriters and paste-up methods with screen-based terminals and a paper-free, server-based system. Newspapers including *The New York Times*, *The Boston Globe* and *Newsday* used Atex, and its impact was global.

In 1986, Rupert Murdoch – publisher of *The Sun* and *The News of the World* – decided to switch his newspapers to Atex. That led to a lengthy, failed strike by print workers and the loss of 6,000 jobs.

Brainerd lost his own job three years earlier when Atex was acquired by the Eastman Kodak Company, but that proved to be the catalyst for a revolutionary move. He spearheaded the development of a new piece of software called PageMaker that allowed entire pages to be produced on screen, with no need to print off strips of text and no requirement to start manually cutting and pasting.

He called this kind of app desktop publishing (DTP) and, while there were two competitors – MacPublisher and Ready, Set, Go! – PageMaker was the best, eventually changing how newspapers and magazines were created. It also paved the way for ordinary people to get in on the action. Creating high-quality publications no longer required expensive kit and hundreds of workers.

Laser focus

PageMaker's success wasn't entirely of its own making. Iit was largely due to being part of a wider set of circumstances involving two huge tech companies, Apple and Adobe.

In 1984, Adobe had unveiled PostScript, a page description language that instructed how digital graphics and text should be printed. Designed in part by the brilliant engineer and Adobe co-founder John Warnock, it allowed precise control over these elements and offered high-quality output to a printer.

In that same year, Apple released the first Mac with a pioneering graphical user interface. It already also sold a 72dpi dot matrix printer called the ImageWriter, introduced in December 1983, but it wanted to produce a relatively low-cost laser printer and was working with Canon on a solution.

Warnock and Adobe's co-founder Chuck Geschke were also planning to manufacture a printer, with a plan to connect to high-end workstations. But Steve Jobs met with Warnock and Geschke, and the plan changed.

The more Jobs discovered about PostScript, the more he liked it, and he asked if he could license the technology to use in Apple and Canon's printer collaboration. Adobe agreed and also dropped plans to make its own hardware. Apple then went on to release the LaserWriter with a Canon LBP-CX engine and built-in PostScript interpreter in March 1985.

The printer was capable of rendering text and graphics at 300dpi, producing output on a par with a typesetter. There was, however, a missing link. It was all well and good connecting a powerful computer to a cutting-edge printer that shared the processing power of a built-in Motorola 68000 chip, but punters needed an application that made the most of this setup.

"We chose the Mac because it appeared to provide the best platform for what we were trying to build"

ABOVE The original Apple Mac gained a strong reputation among creatives because of software such as PageMaker.

Contacts book

Brainerd formed the Aldus Corporation to develop PageMaker and it was to be released on the PC. Assisting him were other Atex workers displaced by Kodak's decision to close the facility in which Brainerd had worked – namely Mike Templeman, Dave Walter, Mark Sundstrom and Jeremy Jaech.

"I had been leading the development of a display ad makeup system, a computer-aided design solution for newspaper and display ads, when we were dismissed," Jaech told *APC*. "We thought we could create a similar system for a broader range of page layouts and we were initially targeting small newspaper chains to replace their lead-type process."

The application was modelled on newspaper pagination programmes, one of which had been created by Atex and used at the *Minneapolis Star* and *Tribune*. The plan was for users to lay out pages electronically, bringing columned text and graphics together and allowing for different-sized type.

Publishing consultant Jonathan Seybold knew Brainerd and also worked with Apple and Adobe. This prompted him to suggest Brainerd get in touch with those companies.

When Brainerd did so, he learned more about the upcoming LaserWriter from its product manager at Apple, Bruce Blumberg. He also discovered details about its PostScript engine from Warnock. What he didn't know was that Apple was trying to kill off the LaserWriter, despite Jobs backing it. It was due to sell for $6,995 and that, justifiably, felt too high for retail.

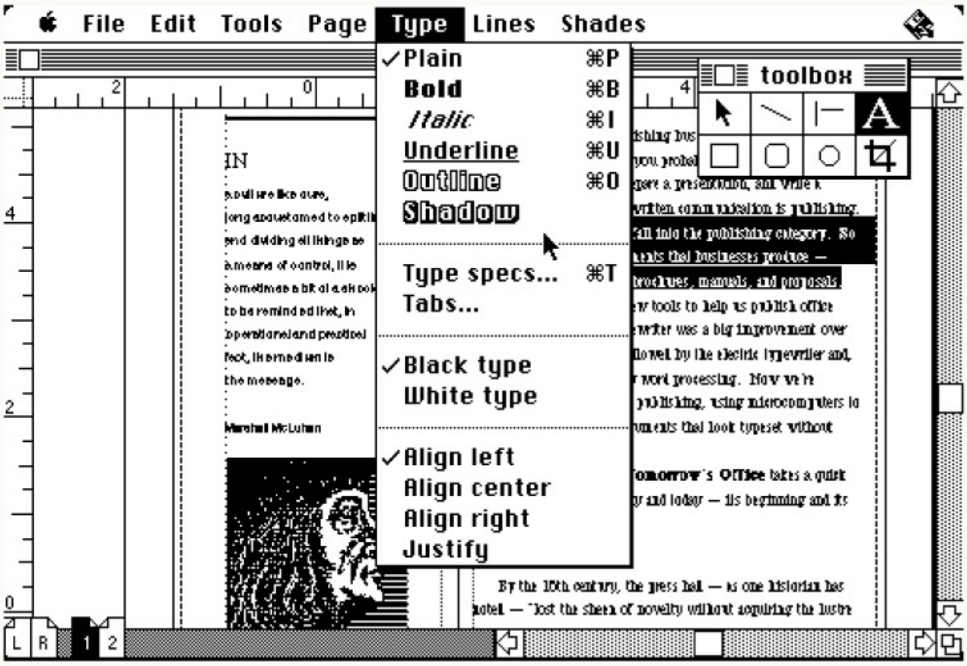
"We chose the Mac because it appeared to provide the best platform for what we were trying to build," Jaech said. And that sentiment was echoed by Brainerd. He told the Computer History Museum in 2006 he had immediately seen the advantage the first Macs would give to page layout (IBM, he said, had "no graphical software interface"). Aldus' decision delighted Jobs immensely.

"At the time, there wasn't any software that could take advantage of the PostScript engine in the printer and it cost twice as much as the HP LaserJet," Jaech said. "So the concept of DTP was created to marry the power of the LaserWriter to PageMaker. It gave companies a reason to buy the printer."

Producing PageMaker

Brainerd concentrated on the marketing at Aldus while the other four co-founders worked on the software. "The five of us were by far the biggest contributors to the first release," said Jaech.

"At that time, software for the Mac had to be developed on an Apple Lisa, and we could only afford two of them, so two developers had access to the Lisas from noon to midnight and the other two from midnight to noon. I slept under my desk many times, as did the other developers."



ABOVE PageMaker introduced many of the terms that are now common in desktop software.

The aim was to produce an intuitive yet rather complex program, inspired by MacDraw and MacPaint, that would be aimed at small businesses, offices, churches, schools and small publishers. If PageMaker had been aimed at the professional newspaper and magazine market immediately, he knew it would fail because decision-making at such companies tended to be slow.

Even so, PageMaker introduced many features used by professionals today. Rulers showed measurements in millimetres, inches or picas to allow accurate placing of the various page elements. There were drawing tools and a function to resize and crop graphics, plus a feature that allowed text to be bent around images.

"PageMaker brought a newspaper layout concept to document creation, the idea that a document consisted of graphics (display advertising in newspapers) and that text flowed around the graphics in 'text holes'," Jaech said. "That is why the 'place' command, which flowed text into a text hole the user chose with the mouse, was the most important feature."

Text could be spread across as many as ten columns of various widths, with leftover words automatically flowing to the next column. Users could change type styles and fonts, page numbering worked automatically, and it was possible to view the screen in full or to zoom in and out by as much as 200%.

"PageMaker introduced users to typography concepts like font, font measurement systems, font families, letter spacing and leading, even kerning, and other advanced concepts," said Jaech. "It taught the idea of assembling a series of pages from parts created by other programs. It introduced columns and margins. It opened up the capabilities of professional printing systems and made them accessible to everyone."

Documents were limited to 16 pages at a time but they could be linked to form larger publications, which got around such restrictions. PageMaker would also double as a simple word processor (although many experts suggested writing text in a dedicated app such as MacWrite and importing it).

Users didn't necessarily have to keep jumping between programs, though. All text could be edited within PageMaker and any alterations would simply cause text to reflow. It was also possible to create master pages, and users could make use of MacPaint and MacDraw files. Just as importantly, while the PostScript files created by PageMaker could be sent to the LaserWriter, they could also be read by Linotronic typesetters.

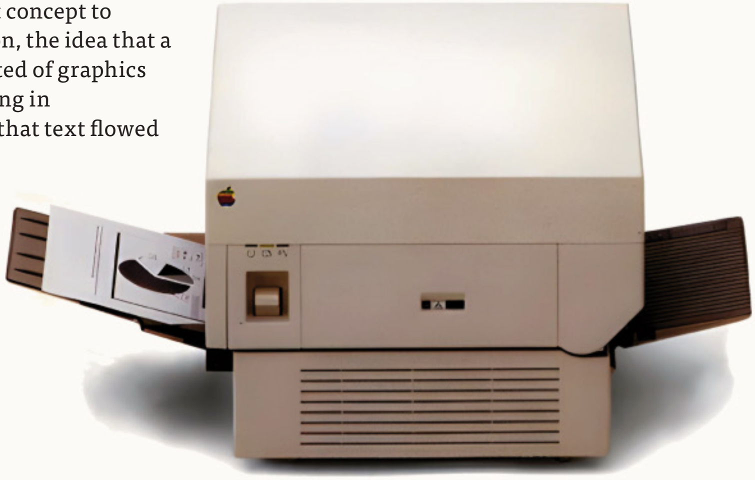
It's no surprise, then, it was so well received on its release in July 1985. A few months later, *InfoWorld* magazine went so far as to say: "PageMaker, together with the Macintosh and the LaserWriter, may become the program that establishes desktop publishing as the new necessity."

The review praised the program for being intuitive, saying it could be learned in half an hour, and even a stiff $495 price didn't dim its enthusiasm. "PageMaker is expensive but this is no lightweight program," the article concluded. "In its way, this could be the Lotus 1-2-3 of business desktop publishing; its combination of powers and potentials make it very good value in its market."

Design notes

Aldus had struck lucky. The three stars – the Mac, LaserWriter and PostScript – had aligned at just the right time. "Apple also paid for the marketing of the combined solution since every time we sold a $500 PageMaker, [it] sold about $15,000 worth of hardware," said Jaech.

This meant Aldus didn't have to spend development money on promoting its program. "We gradually added staff for customer service and operations," Jaech



RIGHT Apple's LaserWriter came with a Motorola 68000 processor.

explained. Before long, people were snapping up the program and buying into Apple's publishing ecosystem, discovering they could produce high-quality brochures, newsletters, magazines and reports at a far lower cost than before.

The what-you-see-is-what-you-get approach worked wonders for this fledgling sector and there are multiple stories of people who say they owe their careers to PageMaker.

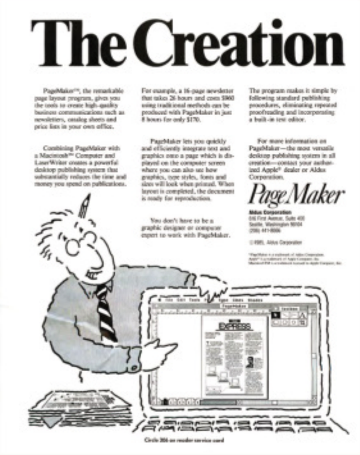
Terry White, principal director and creative cloud evangelist at Adobe, recently posted on X saying the PageMaker, Mac, LaserWriter, PostScript combination prompted him to quit his job and open a desktop publishing business. "Traditional typesetters on Compugraphic laughed at me and my 300dpi output and thought it would never replace what they used," he wrote.

Yet some of those naysayers were likely acting out of fear for their jobs – or they were looking at some people's PageMaker designs with despair. So many PageMaker users were making a dog's dinner out of their designs using every font or effect at their disposal.

This wasn't Aldus' fault, nor anything to do with the tools, but the "ransom note effect" – the result of using too many typefaces – and a poor eye for what looked good on the page.

> "QuarkXPress became a major competitor, and Adobe ended up buying Aldus in 1994 before producing its own rival, InDesign, five years later."

So marketing expert and author Roger C Parker approached Aldus and proposed a slim book that explained the basic elements of design, which ended up being given away to PageMaker's registered users. Parker followed it up with the bestseller *Looking Good in Print: A Guide to Basic Design for Desktop Publishing*. Magazines also ran tutorials giving readers a grounding in design.



The Creation

PageMaker™, the remarkable page layout program, gives you the tools to create high-quality business communications such as newsletters, catalog sheets and price lists in your own office.

Combining PageMaker with a Macintosh™ Computer and LaserWriter creates a powerful desktop publishing system that substantially reduces the time and money you spend on publications.

For example, a 16-page newsletter that takes 28 hours and costs $860 using traditional methods can be produced with PageMaker in just 8 hours for only $170.

PageMaker lets you quickly and efficiently integrate text and graphics onto a page which is displayed on the computer screen where you can also see how graphics, type styles, fonts and sizes will look when printed. When layout is completed, the document is ready for reproduction.

You don't have to be a graphic designer or computer expert to work with PageMaker.

The program makes it simple by following standard publishing procedures, eliminating repeated proofreading and incorporating a built-in text editor.

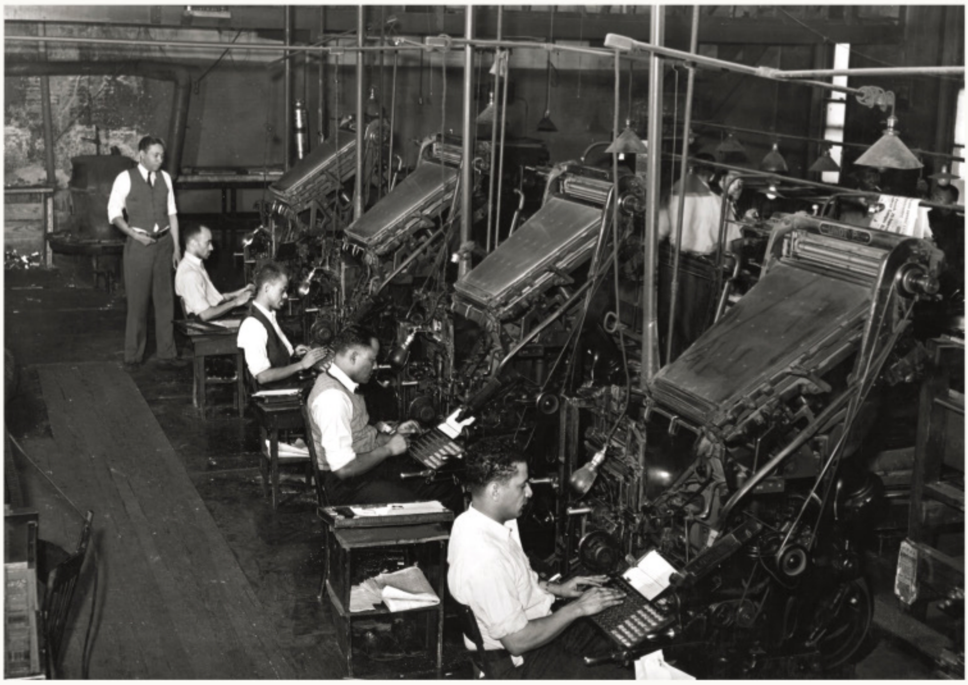
For more information on PageMaker—the most versatile desktop publishing system in all creation—contact your authorized Apple® dealer or Aldus Corporation.

PageMaker

Aldus Corporation

LEFT Adverts for PageMaker highlighted its speed, economy and ease of use.

BELOW Hot metal typesetting was used in professional publishing before the arrival of DTP.



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The next page

Aldus created further versions of PageMaker and it led to a growth in small-scale and independent publishing from local magazines to fanzines. In that sense, it democratised publishing and sped up the production process, allowing for greater design experimentation and giving publishers and writers greater control over their work.

"Many things were published that would never have been published using the old gluepot and exacto knife page paste-up method," said Jaech. "We knew we had a winner when we surveyed our customers to ask what they were creating with PageMaker and got back a wide range of answers."

Yet PageMaker's success was not to last. While it had a good run (and soon appeared on the PC), other companies weren't going to allow it to dominate. By the end of the 1990s, it had effectively lost the professional market while the LaserWriter was losing out to more cost-effective models with comparable features.

QuarkXPress became a major competitor, and Adobe ended up buying Aldus in 1994 before producing its own rival, InDesign, five years later. Adobe continued to produce PageMaker up until version 7.0 in 2001 but brought down the axe in 2004, just short of its 20th birthday.

By then, PageMaker had done its job. "It set a standard for what a good-looking page should look like," Jaech told us. "The word processor makers all took the ideas into their products and people just expected printed material to look better than it had in the past.

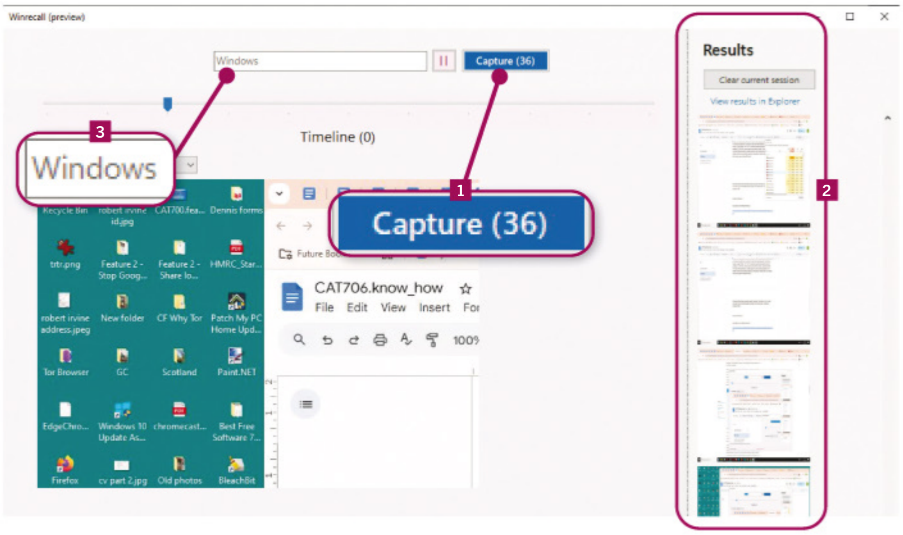
"Users learned about fonts, font families, font size, letter spacing and so on and then expected to be able to control those and many other type characteristics in the products they used."

Such lessons continued beyond print, influencing how websites are created. The design literacy fostered by PageMaker is also sure to live on for many more years to come. ■

KNOW HOW

Intrigued by Microsoft's controversial new AI tool for Copilot+ PCs, Robert Irvine tries to…

Use Windows Recall privately



Winrecall captured snapshots of Robert's screen too frequently for his liking.

Microsoft has made many blunders over the years, which inevitably attract more attention than mistakes by smaller tech companies. These range from poorly designed operating systems such as Windows 8 to unpopular devices like its Zune portable media player.

The latest example of Microsoft's apparent folly is Recall, the AI feature it announced last year to an immediate and widespread backlash. Designed for new Copilot+ PCs, Recall takes snapshots of everything you see and do on your computer, then analyses the content using AI, so you can easily search for it later.

Recall sounds like the definition of a privacy nightmare, especially when it was rumoured that details of users' activities would be shared with Microsoft. The company later clarified this wouldn't be the case and that the feature would be disabled by default, but by then the damage was done and Recall was being flagged as a reason not to buy a Copilot+ PC.

However, the concept behind Recall isn't without merit. Our PCs already save details of our activities – including files we open and websites we visit – so why not extend that to cover all tasks and make the content searchable? The answer of course is that nobody wants to be spied on, whether by Microsoft or AI.

So I was intrigued to discover a new open-source tool called Winrecall (**github.com/builtbybel/Winrecall**), which claims to replicate some of Recall's functionality. The differences being that it doesn't require a Copilot+ PC, has nothing to do with Microsoft and is able to work offline using AI and OCR.

I downloaded Winrecall from **github.com/builtbybel/Winrecall/releases/tag/0.25** and extracted the contents of its ZIP file (find it under the Assets heading). I then double-clicked its installer and chose 'More info' then 'Run anyway' at the expected SmartScreen warning. When the program opened, it prompted me to set an encryption key to protect my data. It also asked me to choose a Capture Mode – 'AI + OCR<' to combine screenshot descriptions with text extraction; or 'OCR Only'. Keen to see if and how the AI worked, I chose the former.

In the main Winrecall window, I clicked Capture to start recording snapshots of my activities. There was no setting to specify the frequency of screen captures, but I believe that's also the case in Microsoft's Recall.

Winrecall confirmed that 'automatic snapshot capturing' had started, so I got on with some work to give it something worth recording. Ten minutes later, I checked its progress to find that it had already captured 36 snapshots (1 in our screenshot), which seemed like too many. I was also perturbed by the whirring noise my laptop was making, suggesting that Winrecall was using a lot of memory.

I paused the capture process but didn't see any snapshots until I started typing into the search box. This displayed them in a Results panel on the right-hand side 2. I searched for Windows 3 and Winrecall instantly showed a snapshot in the main window. This indeed contained the word 'Windows' in the title of a browser tab within the captured image.

Double-clicking the snapshot opened it full-size in my default image viewer, where I confirmed it had captured my entire screen. I was also able to see the text Winrecall had extracted from each screenshot, by hovering my cursor over the thumbnails in the Results panel.

Clicking the 'View results in Explorer' link opened the folder containing the images, while the 'Clear current session' button deleted them all. Less useful was the Timeline slider, which showed an error message when dragged.

I'm sure the real Windows Recall is much slicker than Winrecall, and lighter on resources, but I'm still uncomfortable with something silently recording in the background.

Without options to set the frequency of snapshots or filter the results by anything other than keywords, you end up with a lot of images to wade through – as well as the sense your whole screen is being watched. ■

> "Designed for new Copilot+ PCs, Recall takes snapshots of everything you see and do on your computer, then analyses the content using AI, so you can easily search for it later."

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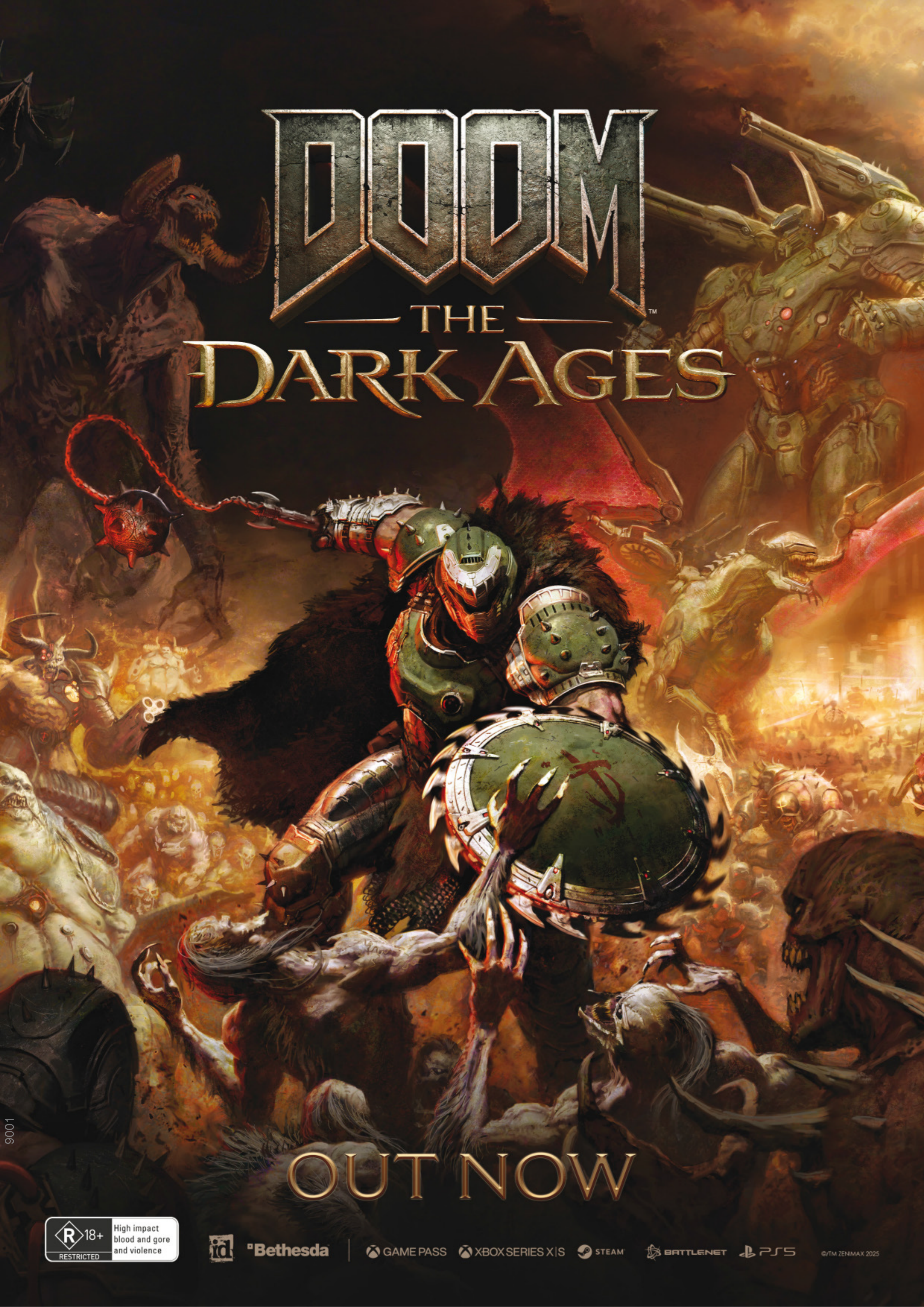
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